TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Nutrients and Dissolved Oxygen

In

Upper Lake Lafayette

Leon County, Florida

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LIST OF ABBREVIATIONS

BMP	Best Management Practices
BOD	Biological Oxygen Demand
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
CHLA	Chlorophyll – a
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OFW	Outstanding Florida Water
OSTD	Onsite Sewer Treatment and Disposal Systems
PLRG	Pollutant Load Reduction Goal
Rf3	Reach File 3
RM	River Mile
NWFWMD	Northwest Florida Water Management District
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBID	Water Body Identification

WCS	Watershed Characterization System
WLA	Waste Load Allocation
WMP	Water Management Plan

1.0 INTRODUCTION

This report presents the technical basis for Total Maximum Daily Loads (TMDLs) for nutrients and Dissolved Oxygen for Upper Lake Lafayette. The lake, which is in the St. Marks River Basin, is located in Tallahassee and Leon County, Florida (Figure 1). The lake was identified as impaired by nutrients based on elevated levels of the Trophic State Index for lakes and on low Dissolved Oxygen levels, and was included on the verified list of impaired waters for the St. Marks Basin that was adopted by Secretarial Order on August 28, 2002.

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

2.0 PROBLEM DEFINITION

For assessment purposes, the watersheds within the St. Marks River Basin have been broken out into smaller watersheds, with a unique **w**ater**b**ody **id**entification (WBID) number. Upper Lake Lafayette, assigned WBID 756A (Figure 1), was assessed using the Impaired Waters Rule (IWR) methodology in Chapter 62-303, Florida Administrative Code (FAC), and was verified as impaired for both nutrients and Dissolved Oxygen.

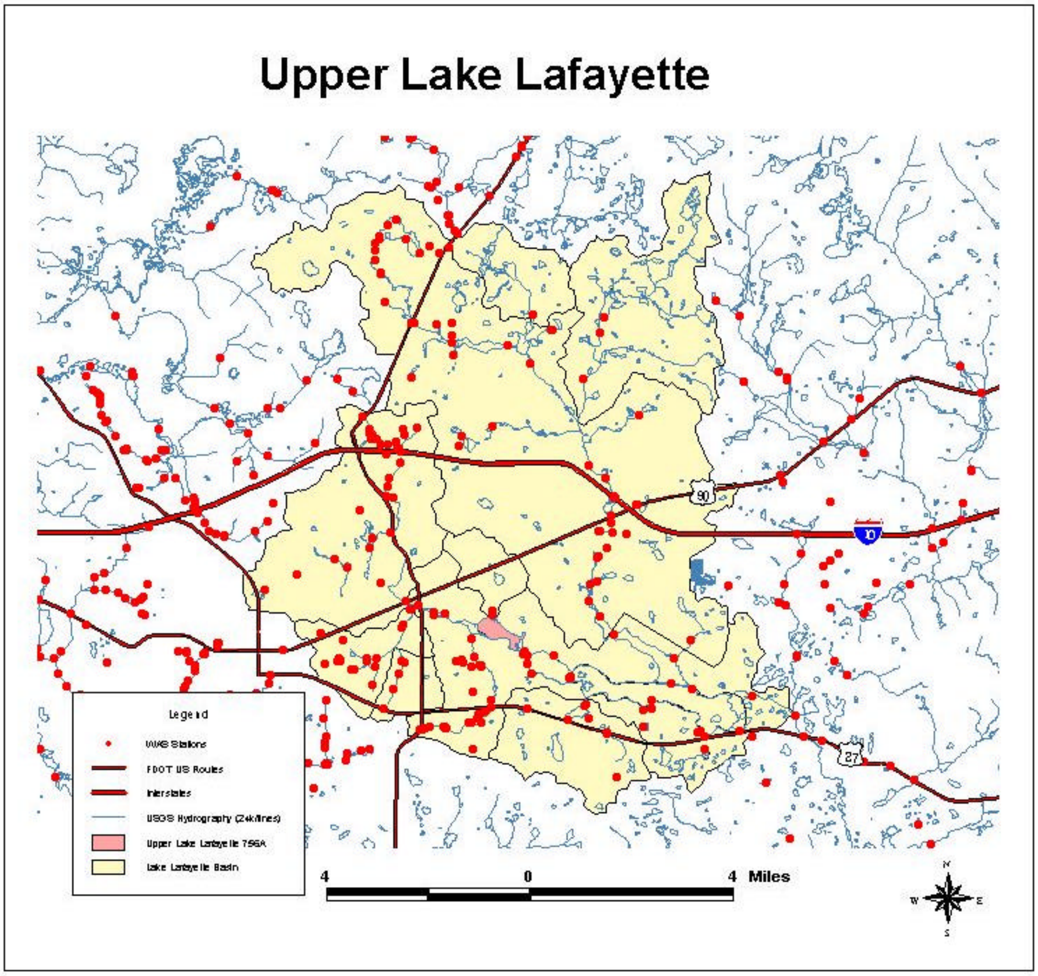
3.0 WATERSHED DESCRIPTION

Water movement through the Lake Lafayette system of lakes is very complex. The portions of Lake Lafayette Drain, which drain into Upper Lake Lafayette, is made up of four primary tributaries: the Northeast Drainage Ditch (NED), Lafayette Creek, a small tributary from the north of the lake, and Lake Piney Z Tributary. Of these four, the Northeast Drainage Ditch and Lafayette Creek are the major sources of flow to the lake. The Northeast Drainage Ditch has its headwaters about six miles north of Upper Lake Lafayette and meanders through a highly urbanized section of Tallahassee. Two urban tributaries, McCord Park Ditch and Park Avenue Ditch, join the Northeast Drainage Ditch before its confluence with Upper Lake Lafayette. Lafayette Creek, with its headwaters approximately three miles from the lake, also flows directly into Upper Lake Lafayette. Recent development has made Lafayette Creek a more urbanized system over the past decades.

Upper Lake Lafayette is the westernmost lake in the Lafayette Lake system. It is highly variable in regards to area and volume, and it exchanges flow with its neighboring lake to the east, Piney Z, at high water level conditions. Piney Z, which has no major tributaries, maintains its water levels via culverts at each end of the lake and is the central lake in the system. Lower Lake Lafayette, whose major tributary is Alford Arm, is the easternmost lake and connects this entire lake system to the St Marks River.

Figure 1. Location of Impaired WBID 756A (Upper Lake Lafayette) in the Lake Lafayette Basin

(map includes water quality monitoring stations)



4.0 WATER QUALITY TARGET IDENTIFICATION

Waterbodies in the Lake Lafayette Basin portion of the St. Marks River Basin are classified as Class III waters, with a designated use classification for recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Class III water quality criteria applicable to the observed impairment include the dissolved oxygen (DO) criterion (5.0 mg/l) and the narrative nutrient criterion (nutrient concentrations of a body of water shall not be altered so as to cause an imbalance in natural populations of aquatic flora or fauna). Because the nutrient criterion is narrative only, a nutrient related target was needed to represent levels at which imbalance in flora or fauna are expected to occur. While the IWR provides a threshold for nutrient impairment for lakes based on a trophic state index (TSI), the TSI approach had limited utility for the lake because of the rapid flushing time for the lake and complex interconnections with ground waters. As an alternative, target Total Nitrogen (TN) and Total Phosphorus (TP) concentrations were also utilized, based on comparisons to unimpacted lakes within the basin.

5.0 WATER QUALITY ASSESSMENT

The locations of monitoring stations in the Upper Lake Lafayette basin are shown on Figure 1. Available data from these stations were compiled and are available in Appendix E. The mean chlorophyll a for the lake was 23.8 ug/L, and mean TN and TP concentrations were 1.165 mg/L and 0.140 mg/L, respectively. These values represent an average TSI value of 50.6.Annual TSI values for Upper Lake Lafayette (Station 858/L02) are available in Figure 2.

Due to the high algal productivity, pH values can increase significantly, with a peak value of 9.0 su when the temperature was 30 °C. Based on NH3N values (McGlynn, 2002) for Lake Lafayette of 0.13 mg/l (mean), un-ionized ammonia values for the lake may be as high as 0.07 mg/l, which exceeds the Class III criterion for fresh waters of 0.02 mg/L. On several occasions, the un-ionized ammonia exceeded criteria when TN was less than 1.0 mg/l.

Appendix C provides estimated TN and TP loads for the Northeast Drainage Ditch for three sampling dates. These graphs depict the distribution of loading for the main tributary to Upper Lake Lafayette for low and high flow conditions.

Figure 3 shows the diurnal change in DO at Upper Lake Lafayette from January 14 – 30, 2003, and Figure 4 shows the diurnal change in DO at Upper Lake Lafayette from April 25, 2003 to May 7, 2003. The DO varied from about 3 mg/l to 14 mg/l, for a DELTDO of 11 mg/l. The data also show that the DO percent saturation exceeded the Total Dissolved Gases criterion for Class III waters (not to exceed 150% of saturation). The DO at Upper Lake Lafayette is sometimes stratified with values of 7.79 mg/l at the surface to 0.35 mg/l near the bottom (McGlynn, 2002, 11-13-01 data).

Figure 2 TSI vs Time

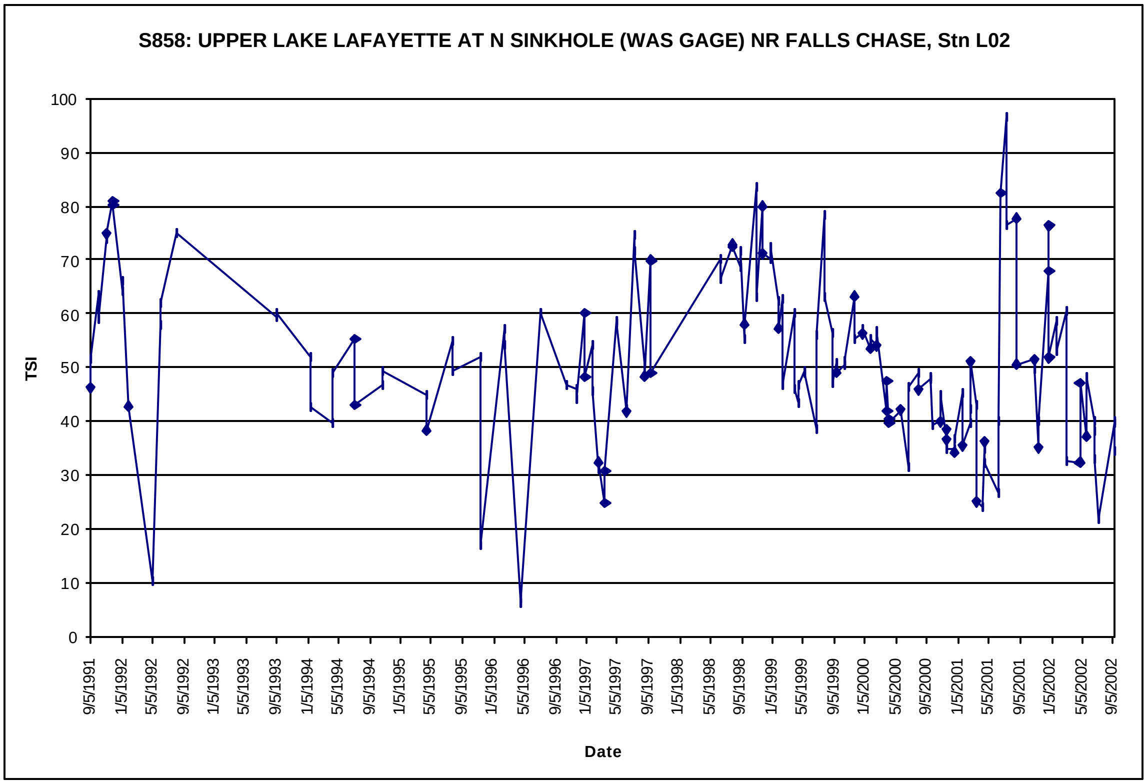


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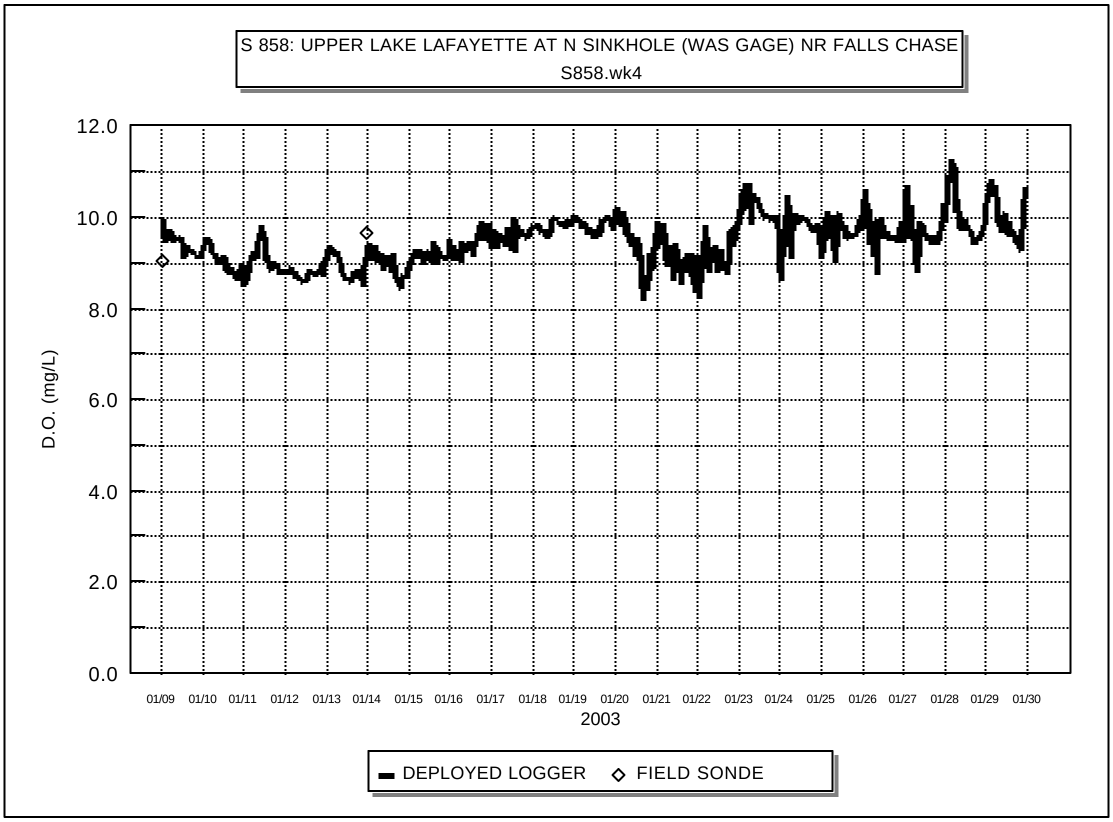
Figure 3: Diurnal Change in DO in Upper Lake Lafayette (January 2003)



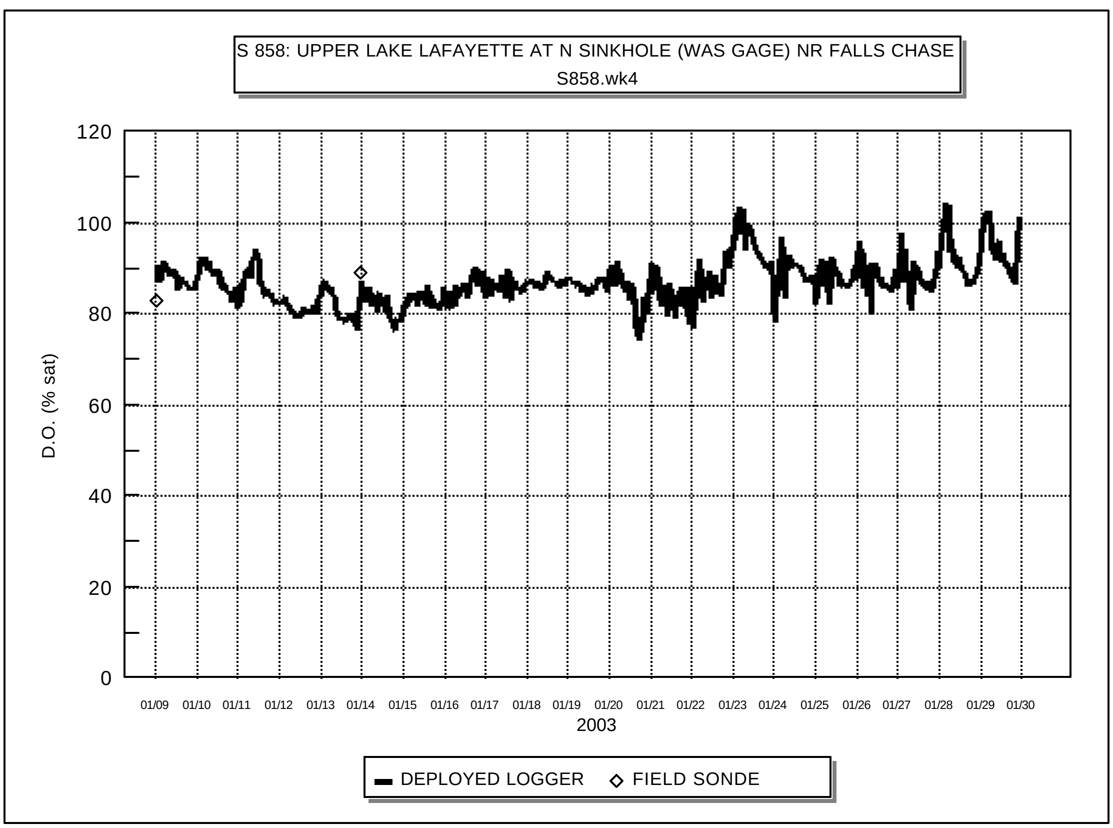
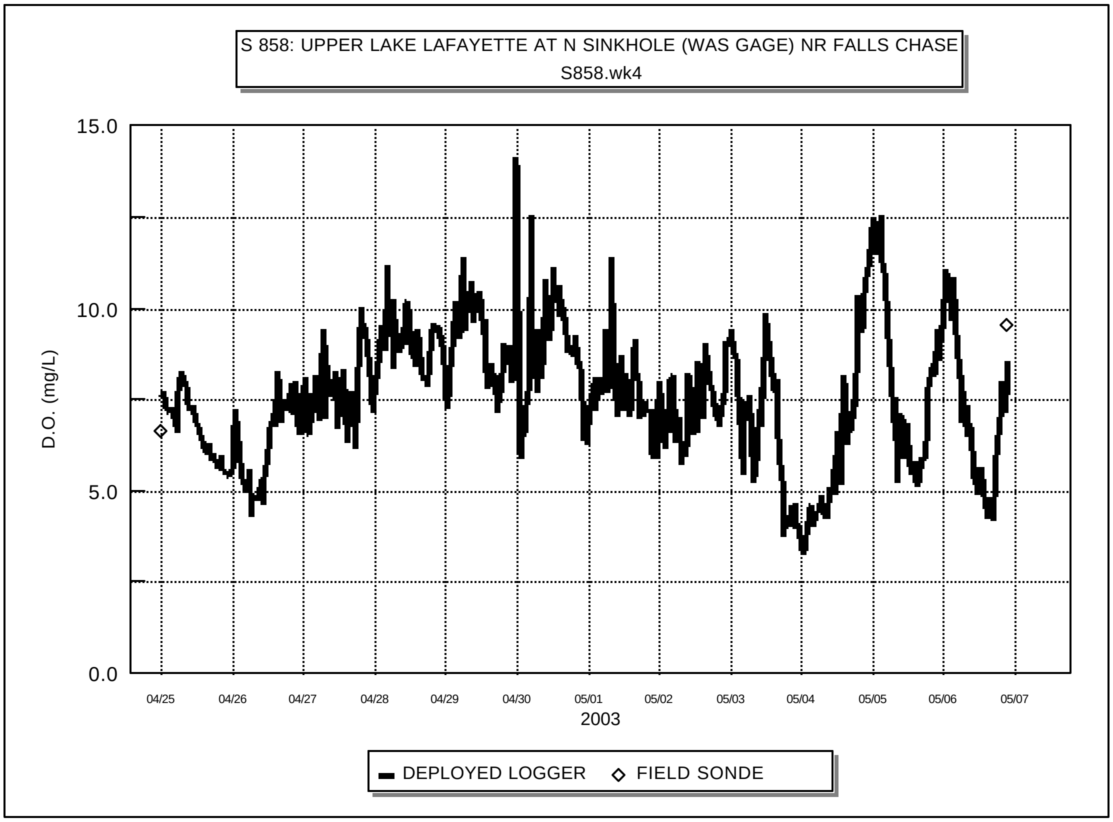
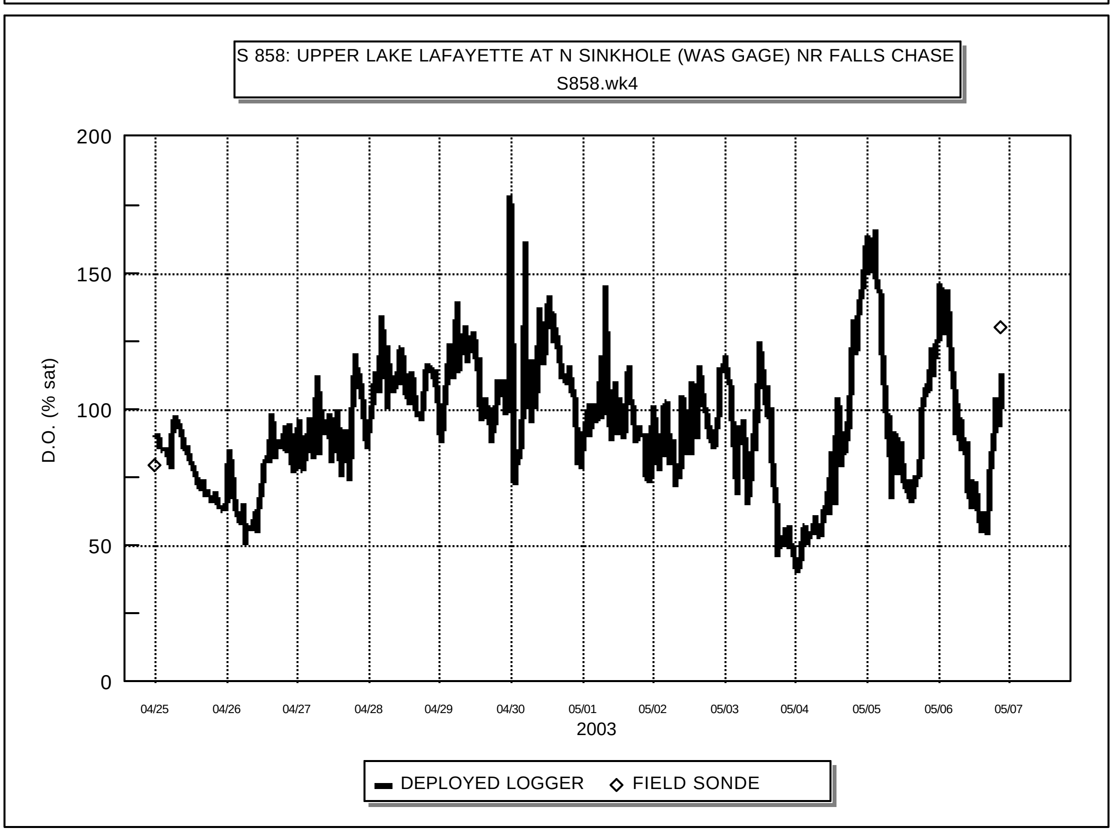


Figure 4: Diurnal Change in DO in Upper Lake Lafayette – April 2003





6.0 Source Assessment

6.1 Source Categories

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of nutrients in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either "point or "nonpoint sources." Historically, the term point sources has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, runoff from agriculture, runoff from silviculture, runoff from mining, discharges from failing septic systems, and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under EPA's National Pollutant Discharge Elimination Program (NPDES). These nonpoint sources included certain urban stormwater discharges, including those from local government master drainage systems, construction sites over five acres, and from a wide variety of industries (see Appendix x for background information about the State and Federal Stormwater Programs).

To be consistent with Clean Water Act definitions, the term "point source" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) AND stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see Section x). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

6.2 Land Use in the Basin

Table 1 contains a detailed land use distribution developed by the City of Tallahassee (ERD, 2002). Table C-2 and C-3, in Appendix C, contain an estimate of TN, TP, TSS and BOD loads using the City of Tallahassee Spreadsheet (ERD, 2002).

6.3 Point Sources

There are several permitted wastewater facilities in the Upper Lake Lafayette drainage area, however, the facilities discharge to percolation ponds, sprayfields, or to the groundwater system. One example of such a facility is the Meadows at Woodrun STP, which discharges to a percolation pond near Lower Lake Lafayette. Another facility is the Leon County Landfill at US 27, which borders the southern shore of Lake Lafayette. There are no NPDES wastewater facilities discharging to surface waters in this basin.

Municipal Separate Storm Sewer Systems (MS4s) may also discharge nutrients to waterbodies in response to storm events. Large and medium MS4s serving populations greater than 100,000 people have been required to obtain an NPDES storm water permit for several years under "Phase I" of the NPDES Storm Water Program, and the City of Tallahassee and Leon County are covered under Phase I of the program.

6.4 Nonpoint Sources

6.4.1 Wildlife

Wildlife deposit nutrients with their feces onto land surfaces where it can be transported during storm events to nearby streams. The nutrient load from wildlife is assumed background, as the contribution from this source is small relative to the load from urban areas. In addition, any strategy employed to control this source would probably have a negligible impact on obtaining water quality standards.

6.4.2 Agricultural Animals

Agricultural animals are the source of several types of nutrient loading to streams. Agricultural activities, including runoff from pastureland and cattle in streams impact water quality. Livestock data from the 1997 Census of Agriculture for the counties encompassing the lake watershed are listed in Table 2. The US Department of Agriculture is currently in the process of updating the agricultural census for 2002. Data from the 2002 Census will be released to the public in Spring 2004. As shown in Table 2, cattle, including beef and dairy cows, is the predominant livestock in these counties. In Leon County, horses represent a significant portion of the livestock in the county. There are no known Confined Animal Feeding Operations (CAFOs) operating in the lake watershed.

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Table 1. Land Cover Distribution

WATERSHED	ROAD	COM-MERCIAL	SINGLE FAMILY LOW DENSITY	SINGLE FAMILY HIGH DENSITY	MULTI-FAMILY RESI-DENTIAL	INDUS-TRIAL	MEDIUM DENSITY RESI-DENTIAL	OPEN WATER / LAKE	REC-REATIONAL / OPEN SPACE	TOTAL WATERSHED
	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)
ALFORD ARM WS	95.29	30.38	711.19	0.73	0	0	238.80	0	1474.14	2550.53
BETTON WOODS WS	158.54	202.12	196.17	45.49	115.07	18.47	280.07	3.10	469.46	1488.50
BUCK LAKE CB	69.07	1.01	236.77	10.64	5.72	0	91.30	0	137.99	552.51
CAPITAL MEDICAL CENTER CB	28.07	53.07	8.39	4.60	77.50	0	2.62	0	78.86	253.10
CELEBRATION BAPTIST CHURCH CB	2.00	13.03	0	0	0	0	2.30	0	0.31	17.64
DESOTO LAKES WS	28.51	0	419.96	0	0	0	0.95	0	597.70	1047.12
EAST 27 CB	5.84	24.00	35.59	0	0	0	1.80	0	202.61	269.84
EAST PARK AVENUE WS	353.89	479.17	113.66	134.71	277.97	86.67	378.06	0	819.56	2643.70
EAST SPRING CHURCH WS	12.20	0.55	544.04	0.20	0	0	15.47	0	465.66	1038.13
FEDERAL CORRECTIONAL INSTITUTION CB	13.42	84.27	0	0	0	3.86	0	0	5.12	106.66
FOLEY DRIVE CB	3.74	2.38	0	0	0	0	15.98	0	7.35	29.45
GILBERT POND WS	47.82	14.15	387.85	0.24	0	0	133.15	0	308.85	892.07
GOOSE POND WS	400.90	285.47	496.63	99.86	105.21	28.50	507.44	33.29	587.67	2544.97
HARRIMAN CIRCLE CB	20.64	0.25	33.62	0	0	0	73.27	0	18.02	145.79
I-10/90 WS	434.90	75.92	1779.22	0	14.09	11.00	338.25	0	2605.76	5259.14
KILLARNEY PLAZA CB	6.22	12.71	0	0.52	2.89	0	7.40	0	0.46	30.20
LAFAYETTE OAKS CB	33.10	13.50	344.16	0	0	0	204.30	0	151.41	746.47
LAKE ELLA CB	40.76	73.55	6.98	11.60	8.57	0.56	23.84	12.84	27.63	206.35
LAKE HERITAGE WS	60.66	14.03	78.86	8.46	11.40	2.47	204.81	0	192.59	573.28
LAKE KANTURK WS	62.98	0.79	82.14	0.73	0	0	248.37	71.18	35.04	501.22
LAKE KILLARNEY WS	123.53	0.43	42.29	38.26	37.60	0	429.81	86.43	308.90	1067.26
LAKE KINSALE WS	22.66	19.26	2.39	16.99	0.86	0.31	53.56	13.37	18.45	147.85
LAKE MCBRIDE WS	37.06	18.02	523.98	1.60	0	0	72.48	0	602.85	1255.99
LAKE SARATOGA WS	82.14	1.74	383.70	0	0	0	221.71	0	285.17	974.46
LAKE SHEELIN CB	37.91	0	0	0.49	0	0	153.66	0	22.07	214.14
LAKE TOM JOHN WS	25.50	0	258.96	1.82	0	0	125.31	0	161.65	573.25
LINCOLN HIGH WS	104.22	207.83	179.52	76.36	76.15	10.81	64.75	0	1079.34	1798.98
LOWER KANTURK WS	9.32	0	3.40	0	0	0	2.67	0	699.82	715.20
LOWER LAFAYETTE WS	111.27	25.15	474.24	2.00	0	0	68.28	0	2624.73	3305.67
MARTINEZ WS	37.90	7.71	680.33	0	0	0	4.73	0	2165.49	2896.16
MAYLOR CB	23.12	21.95	150.67	2.21	9.44	0	75.64	0	98.64	381.67
MCCORD PARK WS	211.51	86.33	159.09	67.71	81.06	0.13	423.67	0	111.62	1141.12
MELODY HILLS CB	22.90	46.91	0.67	6.96	4.80	0	8.68	0	86.03	176.96
MILES WS	24.07	0	419.51	0	0	0	0.48	0	1047.95	1492.01
MILLSTONE CREEK WS	100.62	58.07	500.84	26.63	1.90	0	130.62	3.69	870.72	1693.09
MOM AND DADS CB	31.53	25.07	229.70	31.53	1.32	4.97	24.35	0	422.98	771.45
MOORE POND CB	51.40	9.35	125.58	11.42	0	0	99.01	76.69	149.89	523.33
MT HORNBEM WS	120.47	13.43	51.90	0	4.56	10.69	198.75	0	1224.97	1624.78
MT SINAI WS	14.02	6.17	155.99	0	0	0	1.70	0	331.63	509.51
PEDRIC CB	25.08	14.97	237.26	0.20	0	3.29	43.69	0	33.45	357.94
PHILLIPS ROAD CB	70.88	135.27	36.22	52.96	6.63	0	79.37	0	51.32	432.66

PIEDMONT WS	85.49	73.27	79.74	4.50	44.96	0	158.42	0	164.22	610.59
PINEY Z WS	47.97	49.15	42.78	0.98	0	0	8.63	0	558.68	708.19
ROBERTS POND WS	44.05	29.94	1372.05	0	0	0	11.31	0	767.05	2224.39
ROYAL OAKS CREEK WS	112.28	8.28	63.41	2.94	4.60	0	417.47	0	138.14	747.12
SMITH 1 CB	25.73	28.75	23.94	1.16	0	0	119.98	0	135.65	335.21
SMITH 2 CB	5.55	0	91.53	0	0	0	12.38	0	64.72	174.17
SMITH 3 CB	14.43	0.11	24.30	5.89	0	0	20.02	0	98.23	162.98
SMITH 4 CB	4.20	0	70.26	0	0	0	0	0	89.86	164.32
SOUTHWOOD PLANTATION CB	3.92	0	43.15	1.09	0	0	0.36	0	56.34	104.85
ST PETERS CB	5.47	4.79	6.96	0.51	0	0	5.89	0	11.66	35.28
UPPER LAFAYETTE WS	102.95	54.61	282.50	3.60	0	23.16	27.19	0	1256.40	1750.40
VEDURA II WS	44.37	35.57	276.05	0.20	0	0	88.76	0	599.70	1044.65
WAVERLY WS	52.10	4.81	66.64	0	0	0	173.77	0	68.62	365.94
WELAUNEE WS	65.94	23.00	123.05	2.14	0	0	59.54	0	982.70	1256.36
WITFIELD PLANTATION CB	67.08	0	77.77	22.63	7.65	0	142.32	0	179.52	496.97
TOTAL	3847.17	2390.28	12735.59	700.56	899.96	204.90	6297.14	300.59	25755.37	53131.55

[1]

Notes:

1. Acreage represents the land use distribution in the Lake Lafayette Watershed (Including the Impaired WBID, Upper Lake Lafayette, 756A).
2. COT updated information on agriculture has not yet been incorporated in the table above.

Table 2. Livestock Distribution in the Lake Lafayette Basin, Leon County, Florida (source: Heitmeyer, 2003)

WATERSHED	WATERSHED AREA	CATTLE	SHEEP	GOATS	HORSES	HOGS	CHICKENS	DEER	DUCKS
	(AC)	(NUMBER)	(NUMBER)	(NUMBER)	(NUMBER)	(NUMBER)	(NUMBER)	(NUMBER)	(NUMBER)
ALFORD ARM WS	2550.53	36	4	7	48	2	12	139	2
BETTON WOODS WS	1488.50	21	2	4	28	1	7	81	1
BUCK LAKE CB	552.51	8	1	2	10	1	3	30	0
CAPITAL MEDICAL CENTER CB	253.10	4	0	1	5	0	1	14	0
CELEBRATION BAPTIST CHURCH CB	17.64	0	0	0	0	0	0	1	0
DESOTO LAKES WS	1047.12	15	2	3	20	1	5	57	1
EAST 27 CB	269.84	4	0	1	5	0	1	15	0
EAST PARK AVENUE WS	2643.70	37	4	7	50	2	12	145	2
EAST SPRING CHURCH WS	1038.13	15	2	3	20	1	5	57	1
FEDERAL CORRECTIONAL INSTITUTION CB	106.66	2	0	0	2	0	1	6	0
FOLEY DRIVE CB	29.45	0	0	0	1	0	0	2	0
GILBERT POND WS	892.07	13	1	3	17	1	4	49	1
GOOSE POND WS	2544.97	36	4	7	48	2	12	138	2
HARRIMAN CIRCLE CB	145.79	2	0	0	3	0	1	8	0
I-10/90 WS	5259.14	74	8	15	99	5	25	288	4
KILLARNEY PLAZA CB	30.20	0	0	0	1	0	0	2	0
LAFAYETTE OAKS CB	746.47	11	1	2	14	1	4	41	1
LAKE ELLA CB	206.35	3	0	1	4	0	1	11	0
LAKE HERITAGE WS	573.28	8	1	2	11	1	3	31	0
LAKE KANTURK WS	501.22	7	1	1	9	0	2	24	0
LAKE KILLARNEY WS	1067.26	15	2	3	20	1	5	54	1
LAKE KINSALE WS	147.85	2	0	0	3	0	1	7	0
LAKE MCBRIDE WS	1255.99	18	2	4	24	1	6	69	1
LAKE SARATOGA WS	974.46	14	1	3	18	1	5	53	1
LAKE SHEELIN CB	214.14	3	0	1	4	0	1	12	0
LAKE TOM JOHN WS	573.25	8	1	2	11	1	3	31	0
LINCOLN HIGH WS	1798.98	25	3	5	34	2	8	98	1
LOWER KANTURK WS	715.20	10	1	2	13	1	3	39	0
LOWER LAFAYETTE WS	3305.67	47	5	9	62	3	16	181	2
MARTINEZ WS	2896.16	41	4	8	55	3	14	158	2
MAYLOR CB	381.67	5	1	1	7	0	2	21	0
MCCORD PARK WS	1141.12	16	2	3	21	1	5	62	1
MELODY HILLS CB	176.96	2	0	0	3	0	1	10	0
MILES WS	1492.01	21	2	4	28	1	7	82	1
MILLSTONE CREEK WS	1693.09	24	3	5	32	2	8	92	1
MOM AND DADS CB	771.45	11	1	2	15	1	4	42	1
MOORE POND CB	523.33	7	1	1	10	0	2	27	0
MT HORNBEM WS	1624.78	23	2	5	31	2	8	89	1

MT SINAI WS	509.51	7	1	1	10	0	2	28	0
PEDRIC CB	357.94	5	1	1	7	0	2	20	0
PHILLIPS ROAD CB	432.66	6	1	1	8	0	2	24	0
PIEDMONT WS	610.59	9	1	2	11	1	3	33	0
PINEY Z WS	708.19	10	1	2	13	1	3	39	0
ROBERTS POND WS	2224.39	31	3	6	42	2	10	122	2
ROYAL OAKS CREEK WS	747.12	11	1	2	14	1	4	41	1
SMITH 1 CB	335.21	5	1	1	6	0	2	18	0
SMITH 2 CB	174.17	2	0	0	3	0	1	10	0
SMITH 3 CB	162.98	2	0	0	3	0	1	9	0
SMITH 4 CB	164.32	2	0	0	3	0	1	9	0
SOUTHWOOD PLANTATION CB	104.85	1	0	0	2	0	0	6	0
ST PETERS CB	35.28	0	0	0	1	0	0	2	0
UPPER LAFAYETTE WS	1750.40	25	3	5	33	2	8	96	1
VEDURA II WS	1044.65	15	2	3	20	1	5	57	1
WAVERLY WS	365.94	5	1	1	7	0	2	20	0
WELAUNEE WS	1256.36	18	2	4	24	1	6	69	1
WITFIELD PLANTATION CB	496.97	7	1	1	9	0	2	27	0
TOTAL	53131.55	750	80	150	1000	50	250	2893	36

6.4.3 Onsite Sewage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs or septic tanks) are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. Table 3 summarizes the number of septic systems by subwatersheds within the Lake Lafayette Basin and provides estimates of countywide failure rates and total daily discharge of wastewater from septic tanks.

Table 3. Septic Table Summary

SEPTIC TANKS						
WATERSHED	SEPTIC FAILURE RATE	SEPTIC TANKS	FAILING SEPTICS	PEOPLE SERVED BY SEPTICS	SEPTIC FLOW	FC RATE FROM SEPTICS
	(percent)	(number)	(number)	(number)	(ml/day)	(cts/day)
ALFORD ARM WS	10	561	56.10	140.25	3.72E+07	3.72E+09
BETTON WOODS WS	.	0	0	0	0	0
BUCK LAKE CB	.	187	18.70	46.75	1.24E+07	1.24E+09
CAPITAL MEDICAL CENTER CB	.	1	0.10	0.25	6.62E+04	6.62E+06
CELEBRATION BAPTIST CHURCH CB	.	0	0	0	0	0
DESOTO LAKES WS	.	65	6.50	16.25	4.31E+06	4.31E+08
EAST 27 CB	.	14	1.40	3.50	9.27E+05	9.27E+07
EAST PARK AVENUE WS	.	0	0	0	0	0
EAST SPRING CHURCH WS	.	132	13.20	33.00	8.74E+06	8.74E+08
FEDERAL CORRECTIONAL INSTITUTION CB	.	0	0	0	0	0
FOLEY DRIVE CB	.	0	0	0	0	0

GILBERT POND WS	.	322	32.20	80.50	2.13E+07	2.13E+09
GOOSE POND WS	.	170	17.00	42.50	1.13E+07	1.13E+09
HARRIMAN CIRCLE CB	.	2	0.20	0.50	1.32E+05	1.32E+07
I-10/90 WS	.	1074	107.40	268.50	7.11E+07	7.11E+09
KILLARNEY PLAZA CB	.	0	0	0	0	0
LAFAYETTE OAKS CB	.	558	55.80	139.50	3.70E+07	3.70E+09
LAKE ELLA CB	.	0	0	0	0.00E+00	0.00E+00
LAKE HERITAGE WS	.	635	63.50	158.75	4.21E+07	4.21E+09
LAKE KANTURK WS	.	235	23.50	58.75	1.56E+07	1.56E+09
LAKE KILLARNEY WS	.	8	0.80	2.00	5.30E+05	5.30E+07
LAKE KINSALE WS	.	17	1.70	4.25	1.13E+06	1.13E+08
LAKE MCBRIDE WS	.	170	17.00	42.50	1.13E+07	1.13E+09
LAKE SARATOGA WS	.	591	59.10	147.75	3.91E+07	3.91E+09
LAKE SHEELIN CB	.	373	37.30	93.25	2.47E+07	2.47E+09
LAKE TOM JOHN WS	.	314	31.40	78.50	2.08E+07	2.08E+09
LINCOLN HIGH WS	.	7	0.70	1.75	4.64E+05	4.64E+07
LOWER KANTURK WS	.	0	0	0	0	0
LOWER LAFAYETTE WS	.	116	11.60	29.00	7.68E+06	7.68E+08
MARTINEZ WS	.	45	4.50	11.25	2.98E+06	2.98E+08
MAYLOR CB	.	86	8.60	21.50	5.70E+06	5.70E+08
MCCORD PARK WS	.	0	0	0	0.E+00	0.E+00
MELODY HILLS CB	.	2	0.20	0.50	1.32E+05	1.32E+07
MILES WS	.	42	4.20	10.50	2.78E+06	2.78E+08
MILLSTONE CREEK WS	.	42	4.20	10.50	2.78E+06	2.78E+08
MOM AND DADS CB	.	34	3.40	8.50	2.25E+06	2.25E+08
MOORE POND CB	.	98	9.80	24.50	6.49E+06	6.49E+08
MT HORNBEM WS	.	11	1.10	2.75	7.29E+05	7.29E+07
MT SINAI WS	.	17	1.70	4.25	1.13E+06	1.13E+08
PEDRIC CB	.	162	16.20	40.50	1.07E+07	1.07E+09
PHILLIPS ROAD CB	.	0	0	0	0	0
PIEDMONT WS	.	3	0.30	0.75	1.99E+05	1.99E+07
PINEY Z WS	.	10	1.00	2.50	6.62E+05	6.62E+07
ROBERTS POND WS	.	226	22.60	56.50	1.50E+07	1.50E+09
ROYAL OAKS CREEK WS	.	23	2.30	5.75	1.52E+06	1.52E+08
SMITH 1 CB	.	45	4.50	11.25	2.98E+06	2.98E+08
SMITH 2 CB	.	4	0.40	1.00	2.65E+05	2.65E+07
SMITH 3 CB	.	4	0.40	1.00	2.65E+05	2.65E+07
SMITH 4 CB	.	27	2.70	6.75	1.79E+06	1.79E+08
SOUTHWOOD PLANTATION CB	.	1	0.10	0.25	6.62E+04	6.62E+06
ST PETERS CB	.	8	0.80	2.00	5.30E+05	5.30E+07
UPPER LAFAYETTE WS	.	112	11.20	28.00	7.42E+06	7.42E+08
VEDURA II WS	.	97	9.70	24.25	6.43E+06	6.43E+08
WAVERLY WS	.	10	1.00	2.50	6.62E+05	6.62E+07
WELAUNEE WS	.	0	0	0	0	0
WITFIELD PLANTATION CB	.	36	3.60	9.00	2.38E+06	2.38E+08
TOTAL		6697	669.70	1674.25	4.44E+08	4.44E+10

Notes:

1. Numbers do not reflect the removal of septic systems by connection to central sewers.
2. Source:Leon County GIS census
3. Estimated from (EPA, 2002) Bacterial Indicator Tool and FDOH web site of annual septic tank repairs.
4. Based on value of 175 gallons per day per tank (EPA, 2002)

6.4.4 Urban Development

Nutrient loading from urban areas is attributable to multiple sources, including storm water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

6.4.5 Nonpoint Loading Calculations

The methodology for computing the existing tributary loads involves using the average values for

TN and TP for the three major tributary inputs to the Upper Lake Lafayette from the various database sources (DOT, FDEP, Leon County, etc.). The average flows for the period of 1993-2002 from two NWFWMD continuous gaged sites were then combined with the average TN and TP concentrations to give an average load for the Northeast Ditch (NED). Average l flows for the Lafayette Creek and Direct Runoff were computed using flow/drainage area ratios. These flows were then combined with the average TN and TP concentrations from those streams to give average (assumed annual) loads (see Tables 6.1 and 6.2)

The City of Tallahassee (COT) nonpoint spreadsheet model (ERD, 2002) was also used for comparison of annual TN and TP loads for watersheds specific to Upper Lake Lafayette.

Atmospheric contributions of TN were developed from the NADP Quincy rainfall site (NADP, 2003), which has monitored the water quality in rainfall since 1984. Using the average TN wet precipitation of NH4N and NO3N, the TNWET value was computed (2.824 lb/d). From Tampa Bay NURP studies (Janicki, 2000), the dry precipitation TNDRY was assumed equal to TNWET for a TNTOT=TNWET+TNDRY of 5.648 lb/d. The TP load was computed from the Quincy site using data from 2000-2002 (Larson, 2003). TPWET value was computed as 4.497E-02 lb/d, with TPDRY=TPWET, the TPTOT= 8.995E-02 lb/d. Using an average rainfall for the area of 4.848 ft/yr, a flow rate QATM= 2.67 cfs was determined for the Upper Lake area of about 400 ac. The "effective" (wet+dry) rainfall concentrations can then be estimated (TNATM=0.392 mg/l, TPATM=6.25E-3 mg/l).

Septic tank inputs are based on the latest versions of FDOH Rule 64E-6 for OSTDS. The average TN (40.5 mg/l) and TP (8.00 mg/l) for failing septic tanks was used. The estimate of flows per tank was based on EPA values of 175 gal/tank/d and an assumed failure rate of 10 % within each subwatershed. The actual failure rate is not known. However, some estimate can be made from the number of septic tank repair permits issued annually by Leon County (274-529/yr from 1993-2002) and the total number of tanks within Leon County (36930).

The loads from livestock and agriculture are included in the tributary concentrations. However, they were not included in the original COT spreadsheet model, which does not include agriculture as a land use component. Recently the COT has supplied information on the agriculture within each watershed (Cox, 2003), but our tables have not yet been updated to reflect these data.

The **Groundwater** contribution is still unknown as well as the source. A variety of TN and TP values can be used depending on the aquifer contributing to the lake.

7.0 ANALYTICAL APPROACH

Several different approaches were used to examine the nutrient impacts to Upper Lake Lafayette, including regression methods, use of the Areal Hypolimnetic Oxygen Demand (AHOD) model, evaluation of reference lake nutrient concentrations, and use of the Reckhow model. Because all of these efforts provided insight into the nutrient dynamics of the lake, each are described briefly below, and additional documentation about each method is available in the bibliography and references (Wieckowicz, 2003) at the back of this document. However, it should be noted that the TMDL is based on the results of the Rechkow model.

Regression Methods

Regression methods examine environmental parameters to determine if there are statistically significant relationships (correlations) between them. In this case, correlations between in-lake concentrations of key parameters and the response of Upper Lake Lafayette water quality to external water quality inputs (nutrient loads and flow) were evaluated as a potential basis for a TMDL. However, there were no statistically significant, relevant relationships between all of the parameters evaluated. An example of the relationship between Upper Lake Lafayette TSI and NED tributary concentrations is shown in Appendix A. The increase of TSI to the IWR threshold of 60 seems to occur near a TN value of 1 mg/l, with TSI values leveling off at higher values of TN??. Similarly the TSI increase to 60 occurs near a TP value of 1.2 mg/l, with TSI values leveling off at higher values of TP. It is possible that excess nutrients are being incorporated into biomass forming algal mats without an increase in chla-a. Details of the regression analysis are available in Appendix A.

No analysis was done to examine the effect that high BOD5 levels (average > 5 mg/l) measured at the NED at Weems Rd have on DO in the Upper Lake, since there is a very limited set of BOD5 data for the lake itself.

Areal Hypolimnetic Oxygen Demand (AHOD)

The AHOD method, which is an empirical zero-order model, looks at the DO stratification within a lake (Chapra, 1997; Thomann, 1987, Reckhow, 1990). Since the area around the Upper Lake Lafayette sinkhole is quite deep, the lake can become stratified during low flow conditions (McGlynn, 2002). When stratified, there is restricted DO transfer from the atmosphere to the lower lake layer (hypolimnion) and lower lake DO levels can decrease well below the criterion.

The AHOD method allows for oxygen demand to be calculated based on the internal lake TP:

$$\text{AHOD } (g/m^2/d) = 0.086 * ((TP)^{\wedge}0.478), \text{ where TP is in ug/l.}$$

Using this equation, a spreadsheet (Appendix B2) was used to calculate the AHOD for various TP concentrations and depletion times (days). For the assessment, the hypolimnion layer was estimated to be three feet and the average inter-event dry period between storms for Tallahassee (4 day; Wanielista, 1993) was used to estimate the stratification period AHOD.
Using a minimum DO target of 1.5 mg/l in the lower lake layer, the estimated TP that would cause this DO depletion, was found to be approximately 0.15 mg/L.

Using a minimum DO target of 5.0 mg/l in the lower lake layer, the estimated TP that would cause a depletion of DO from a saturated value (DO =7.54 mg/l at 30 DEGC) to the target DO is about 0.04 mg/l.

Supersaturated DO due to CHLA

Most of the DO measurements available for the lake were discrete samples collected during the day and do not reflect the lowest values from the diurnal cycle. To predict the low levels of DO that may occur at night or early morning, a technique can be used to estimate diurnal dissolved oxygen swings based on estimates of algal biomass and basic information about the water under study (Nicol, 1984), (Thomann, 1987), (Chapra, 1997). This procedure has been updated as an Excel spreadsheet model (Appendix B3) that calculates the range of DO expected (DELTDO) given reaeration rates, depths, Secchi depths, and chlorophyll a. If we assume that the 24-hour average

DO is 5.0 mg/l, a DELTDO of 7 mg/l would drop the DO to the anaerobic range of 1.5 mg/l. This corresponds to a CHLA of about 50 ug/l. If we assume that the DO is saturated (DOSAT= 7.54 mg/l), then a DELTDO of 5.0 mg/l would drop the DO to 5.0 mg/l. This corresponds to a CHLA of about 30 to 40 ug/l.

Results from the Diurnal spreadsheet for Upper Lake Lafayette show DELTDO computed on a monthly basis varied from a low of 1.4 mg/L at a chlorophyll a level of 10 ug/L to about 14 mg/L at a chlorophyll a of 100 ug/L. These model estimates are consistent with the measured DO values (described previously) which varied from 3 mg/L to 14mg/L, with a DELTDO of 11 mg/L.

Reckhow Model

The Reckhow Model (Reckhow, 1990) is an empirical relationship that predicts in-lake TN, TP, chlorophyll a, and secchi depth from lake morphology and TN and TP loadings. It is usually applied on an annual basis when dealing with hydrologically stable lakes. Unfortunately, Upper Lake Lafayette is not hydrologically a simple system. The karst features, including one large sink and several other sinkholes and other groundwater-surfacewater interactions, does not provide a stable depth, area, or volume.

In order to utilize the Reckhow Model (or any model) of this system, a water balance must be first be developed. This has not yet been accomplished because there is very limited historical flow data . However, as an alternative, monthly average flow values for 1993-2002 (FDEP Stations 695, 810, and 860) were used to compute typical lake depths, areas, volumes, and flushing times. GIS data from 1 ft contours were used to calculate the Upper Lake area and volume versus elevations in NGVD.

Loading of nutrients was then estimated assuming constant values for tributary TN and TP. Using the Reckhow formulation, monthly values of in-lake TN, TP, chlorophyll a, secchi depth, and TSI were predicted (see figures in Appendix B1). A variety of combinations of TN and TP tributary concentrations were used along with a range of lake elevations. The set of tributary TN=1.0 mg/l and TP=0.12 mg/l gave an average TSI that was below the IWR criteria of 60, with a 10% MOS. However, this is not the only set of (TN,TP) numbers that will yield an acceptable TSI. The spreadsheet summarizing these calculations is in Appendix E. [I just can’t understand what you did. Please try to clarify, specifically noting what data/modeling were used to estimate loads to the lake, and how resultant concentrations were used to then calculate the allowable load to the lake.]

Reference Lakes

The last method used to estimate the acceptable nutrient loading to Upper Lake Lafayette was to evaluate data for other, non-impacted (reference) lakes in the area. The reference lakes that were evaluated were Lake Hall and Lake McBride. Lake Hall, which is part of Maclay Gardens State Park, is an Outstanding Florida Water and is near the headwaters of the NED. Lake McBride is another nearby high quality lake. It is the headwaters of Alford Arm and drains to Lower Lake Lafayette. Both Lake Hall and Lake McBride have maintained stable TSIs below 60 for the past ten years (McGlynn, 2002) and provide an estimate of the TN and TP loading to maintain this TSI and natural, diurnal DO variation in Upper Lake Lafayette. Water quality nutrient data summaries of these lakes and other lakes in the area are shown in Table 4, along with Upper Lake Lafayette, Piney Z, Lower Lake Lafayette, and Alford Arm data.

The average values of all of the TN and TP for Lake Hall and Lake McBride, along with the EPA reference conditions, were then calculated to develop potential target nutrient concentrations for Upper Lake Lafayette (TN= 0.52 mg/l and TP=0.032 mg/l.). However, these values were not used as the basis for the TMDL because they do not take into account the capacity of the reference lakes to assimilate nutrients and still maintain a balanced population of flora and fauna.

Table 4 Reference Lake Background Values

Water Body	Data Source	TN (mg/L) Min	TN (mg/L) Max	TN (mg/L) Mean	TP (mg/L) Min	TP (mg/L) Max	TP (mg/L) Mean
Lake Hall	McGlynn H01, H06	0.07	1.13	0.38	0	0.085	0.026
Lake Hall	Lakewatch	0.223	0.697	0.358	0.007	0.049	0.015
Lake McBride	Bradfordville Stormwater Study	0.39	0.905	0.599	0.007	0.47	0.066
Lake McBride	McGlynn MB1, MB3, MB6	0.15	2.03	0.74	0	0.29	0.051
Lake McBride	Lakewatch	0.39	0.905	0.585	0.018	0.064	0.035
Lake McCord Pond	Lakewatch	0.83	0.83	0.83	0.103	0.103	0.103
Alford Arm	Lakewatch	0.553	1.28	0.839	0.024	0.074	0.04
Upper Lake Lafayette	McGlynn L02	0.026	18.143	1.206	0	0.592	0.132
Upper Lake Lafayette	FDEP S858	0	0.654	0.165	0.063	0.21	0.13
Piney Z	Lakewatch	0.507	0.507	0.507	0.023	0.023	0.023
Lower Lake Lafayette	McGlynn L15	0.034	3.113	0.654	0	0.787	0.078
Lower Lake Lafayette	McGlynn L20	0.078	6.76	0.971	0.003	0.933	0.111
Lower Lake Lafayette	McGlynn L21	0.125	4.972	0.982	0.005	1.295	0.119
Lower Lake Lafayette	McGlynn L22	0.549	9.671	2.424	0	1.868	0.352
Florida Lakes	Mark Friedemann and Joe Hand	0.4	3.8	1.4	0.01	0.71	0.07

8.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

The objective of a TMDL is to provide a basis for allocating acceptable loads among all of the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (Waste Load Allocations), nonpoint source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

As mentioned in Section 4.1, the WLA is broken out into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program:

$$TMDL \cong \sum WLAs_{wastewater} + \sum WLAs_{NPDES\ Stormwater} + \sum LAs + MOS$$

It should be noted that the various components of the TMDL equation may not sum up to the value of the TMDL because a) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is accounted for within the LA, and b) TMDL components can be expressed in different terms [for example, the WLA for stormwater is typically expressed as a percent reduction and the WLA for wastewater is typically expressed as a mass per day].

WLAs for stormwater discharges are typically expressed as "percent reduction" because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges is also different than the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the "maximum extent practical" through the implementation of Best Management Practices.

This approach is consistent with federal regulations [40 CFR § 130.2(I)], which state that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or **other appropriate measure**. The TMDLs for Upper Lake Lafayette are expressed in terms of kilograms per year (kg/y), and represent the maximum annual load the lake can assimilate and maintain the narrative nutrient criterion. The TMDLs are also expressed in terms of the percent reduction required to achieve water quality criteria (see Table 5). The allowable nutrient loads to the lake were estimated from the nutrient concentrations for the Reckhow analysis described previously (TN=1.0 mg/l and TP=0.12 mg/l) [this is okay if you explain how the concentrations were used to calculate loads].

Table 5. TMDL Components

WBID	Parameter	WLA		LA (kg/year)	MOS	TMDL (kg/year)	Percent Reduction
		Wastewater (kg/year)	NPDES Stormwater (Percent Reduction)				
756A	TN	N/A	NA	15,725.4	Implicit	15,725.4	NA
756A	TP	N/A	39%	1,789.9	Implicit	1,789.9	39

8.1 Critical Conditions

Upper Lake Lafayette is highly variable in depth, area, and volume, all of which change as a function of the rapid runoff from the urban area. Given this variability, the critical condition for Upper Lake Lafayette nonpoint source nutrient loading is likely an extended dry period followed by a rainfall runoff event. During the dry weather period, nutrients build up on the land surface, and are washed off by rainfall. Because of the rapid flushing time of the lake, the TMDL would ideally be expressed in terms of monthly loads. However, given the methodology used to establish this TMDL, which uses long-term average nutrient concentrations and a theoretical lake volume, the TMDL has been expressed in terms of an annual average load. This is consistent with most lake TMDLs because most lake analyses address a stable lake area and volume that buffer large and small flow and nutrient inputs.

8.2 Margin of Safety

There are two options for incorporating an MOS in a TMDL analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In these TMDLs, an implicit MOS was used to account for the uncertainty regarding in-lake processes

8.3 Waste Load Allocations

<u>NPDES Stormwater Discharges</u>

As noted previously, load from stormwater discharges permitted under the NPDES Stormwater Program are placed in the WLA, rather than the LA. This includes loads from municipal separate storm sewer systems (MS4). Based on the 2000 census, the Lake Lafayette watershed includes areas that are covered by the MS4 Program, and the WLA for stormwater discharges is a 39 percent reduction of current TP loading from the MS4, which is the same percent reduction that is required for all nonpoint sources. It should be noted that any MS4 permittees will only be responsible for reducing the loads associated with stormwater outfalls for which it owns or otherwise has responsible control, and is not responsible for reducing other nonpoint source loads within its jurisdiction.

<u>NPDES Wastewater Discharges</u>

There are no known wastewater discharges in the Lake Lafayette and the WLA for wastewater is therefore not applicable.

8.4 Load Allocations

The allowable LA is 15,725.4 kg/year for TN and 1,789.9 kg/year for TP. This corresponds to reductions from the existing loadings of 39 percent for TP and no reduction for TN. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the Water Management Districts that are not part of the NPDES Stormwater Program (see Appendix F).

[Rich, the last few paragraphs in this section just baffle me. When need to discuss ASAP so that we can figure out how to better clarify how this information was used to determine the allowable load. My initial reaction is that it wasn't ultimately used as part of the simplified approach take and should not be included, but I readily admit I might be missing something. We have to clearly articulate what you did to come up with final TMDLs and allocations.]

There are two modes of transport for nonpoint source nutrient loading into the stream. First, loading from failing septic systems and animals in the stream are considered direct sources to the stream, as they are independent of precipitation. The second mode involves loading resulting from nutrient accumulation on land surfaces that is transported to the stream during storm events.

The inputs to Upper Lake Lafayette were divided into several categories as shown in Tables 6.1 and 6.2. These categories include the tributaries to Upper Lake Lafayette (Northeast Drainage Ditch, Lafayette Creek, and Direct Runoff), atmospheric deposition, septic tanks, hyacinth transport, and groundwater. While it is known that the lake drains to the ground water via sinks and seepage, no estimates have been made of seepage rates into the lake.

The City of Tallahassee (ERD, 2002) spreadsheet model predictions of annual loading for TN and TP are also listed in Tables 6.1 and 6.2.

The allowable loads (LA) for the atmospheric category was assumed to be the same as existing loads. Failing septic tank loads were eliminated per FDOH Rule 64E-6. The allowable TN and TP concentrations for the three tributary inputs were assumed to be TN=1.0 mg/l and TP=0.12 mg/l. The % reductions for TN and TP have been developed for septic tanks and the three tributary sources comparing both existing and allowable loads as well as COT predictions and allowable loads.

Table 6.1 TN TMDL Loading

NUTRIENT TMDL FOR UPPER LAKE LAFAYETTE														
ULLITMDL.WK4 SEPT 16, 2003							COT	COT						
							MODEL	MODEL						
							SOURCE	SOURCE*						
							LOAD	CONVEYANCE						
								LOSS				%	%	
LOAD ALLOCATIONS (LAS)			EXISTING LOADING					0.5				REDUC.	REDUC.	ALLOWABLE
SOURCE LOADING			Q ANN						ALLOWABLE LOADING			MEASURE	MODEL	LOADING
		DA	AVG	TN	TN	TN	TN	TN	TN	TN	TN			TN
		AC	CFS	MG/L	LB/D	LB/YR	LB/YR	LB/YR	MG/L	LB/D	LB/YR			KG/YR
ATMOSPHERIC DEPOSITI		400	2.67	0.392	5.641	2059.107	NA		0.392	5.641	2059.107	1.0784E-17	100*(H11-I	934.01
DIRECT RUNOFF		1350	1.58	0.372	3.168	1156.330	1376	688	1	8.516	3108.413	-168.82	-125.90	1409.98
NORTHEAST DITCH		11011.1	12.889	0.577	40.085	14631.089	23643	11821.5	1	69.472	25357.174	-73.31	-7.25	11502.01
LAFAYETTE CREEK		1799	2.106	0.467	5.301	1934.893	2717	1358.5	1	11.351	4143.239	-114.13	-52.49	1879.37
HYACINTH TRANSPORT					4.4	1606.000								
SEPTIC TANKS FAILED		NA	0.0055	40.5	1.201	438.227	NA	NA	NA	NA	NA	100.00		
GROUNDWATER		400												
TOTAL			19.251		59.796	21825.646	27736	13868		94.981	34667.933	-58.84	-24.99	15725.37

ATMOSPHERIC DEPOSITION BASED ON NADP SITE IN QUINCY FLA MAX VALUES FROM (TN 1984-2002, TP 2000-2002)
AND TAMPA BAY NURP STUDY
TNWET=2.888 (KG/HA/YR)*(400 AC)*(0.4047 HA/AC)*(2.2046 LB/KG)=1030.7 (LB/YR)*(1 YR/365 DAYS)= 2.824 (LB/D)
TNTOT=TNDRY+TNWET=TNWET+TNWET=2.0*TNWET=5.648 (LB/D)
TPWET=0.046 (KG/HA/YR)*(400 AC)*(0.4047 HA/AC)*(2.2046 LB/KG)=16.417 (LB/YR)*(1 YR/365 DAYS)= 4.497E-02 (LB/D)
TPTOT=TPDRY+TPWET=TPWET+TPWET=2.0*TPWET=8.995E-02 (LB/D)
QATM=4.848 FT/YR* 400 AC* 4.35E4 (FT^2/AC)=8.70E7 (FT^ 3/YR)*(3.171E-8 YR/SEC)=2.67 CFS
TNATM=2.824 (LB/D)*(1/5.39)*(1/QATM)=0.392 (MG/L)
TPATM=8.995E-02 (LB/D)*(1/5.39)*(1/QATM)=6.25E-3 (MG/L)
QSEPTIC= 315 TANKS IN BASIN*(0.10 FAILURE RATE)*175 (GAL/D)*1.E-6(MGD/GAL)=5.513E-3 (CFS)
CBOD5=180.0, TSS=120.5, TN=40.5, TP=8.0 MG/L ARE MEANS FROM RULE 64E-6 FAC EFFECTIVE 4-21-2002
QNED (STATION 695 AT WEEMS RD)=(QNED (STATION 690 AT US 319)/(DA S690))*(DA S695)
QNED (S695)= (11.910/10175)*(11011.1)=12.889 CFS
QDIRECT= (QNED S690/DA S690 NED)*(DA DIRECT)= (11.910/10175)*(1350)=1.5802 CFS
QLAFCRK (S810)=(QNED S690/DA S690 NED)*(DA S 810 LAFCRK)=(11.910/10175)*(1799)=2.1058 CFS
QGW= QSEEPAGE RATE* 400 AC=

Table 6.2 TP TMDL Loading

DRAFT

NUTRIENT TMDL FOR UPPER LAKE LAFAYETTE													
ULLITMDL.WK4 SEPT 16, 2003							COT	COT					
							MODEL	MODEL					
							SOURCE	SOURCE*					
							LOAD	CONVEYANCE					
								LOSS				%	%	
LOAD ALLOCATIONS (LAS)		EXISTING LOADING						0.5				REDUC.	REDUC.	ALLOWABLE
SOURCE LOADING		Q ANN							ALLOWABLE LOADING			MEASURE	MODEL	LOADING
	DA	AVG	TP	TP	TP	TP	TP	TP	TP	TP			TP
	AC	CFS	MG/L	LB/D	LB/YR	LB/YR	LB/YR	MG/L	LB/D	LB/YR			KG/YR
ATMOSPHERIC DEPOSITI	400	2.67	6.2500E-03	0.090	32.830	NA		6.2500E-03	0.090	32.830	0	100*(H11-L1	14.89
DIRECT RUNOFF	1350	1.58	0.0918	0.782	285.352	421	210.5	0.12	1.022	373.010	-30.72	11.40	169.20
NORTHEAST DITCH	11011.1	12.889	0.198	13.755	5020.720	5684	2842	0.12	8.337	3042.861	39.39	46.47	1380.24
LAFAYETTE CREEK	1799	2.106	0.1296	1.471	536.964	733	366.5	0.12	1.362	497.189	7.41	32.17	225.52
HYACINTH TRANSPORT				0.88	321.200								
SEPTIC TANKS FAILED	NA	0.0055	8	0.237	86.563	NA	NA	NA	NA	NA	100.00		
GROUNDWATER	400												
TOTAL		19.251		17.215	6283.630	6838	3419		10.811	3945.889	37.20	42.29	1789.86

ATMOSPHERIC DEPOSITION BASED ON NADP SITE IN QUINCY FLA MAX VALUES FROM (TN 1984-2002, TP 2000-2002)

AND TAMPA BAY NURP STUDY

TNWET=2.888 (KG/HA/YR)*(400 AC)*(0.4047 HA/AC)*(2.2046 LB/KG)=1030.7 (LB/YR)*(1 YR/365 DAYS)= 2.824 (LB/D)

TNTOT=TNDRY+TNWET=TNWET+TNWET=2.0*TNWET=5.648 (LB/D)

TPWET=0.046 (KG/HA/YR)*(400 AC)*(0.4047 HA/AC)*(2.2046 LB/KG)=16.417 (LB/YR)*(1 YR/365 DAYS)= 4.497E-02 (LB/D)

TPTOT=TPDRY+TPWET=TPWET+TPWET=2.0*TPWET=8.995E-02 (LB/D)

QATM=4.848 FT/YR* 400 AC* 4.35E4 (FT^2/AC)=8.70E7 (FT^ 3/YR)*(3.171E-8 YR/SEC)=2.67 CFS

TNATM=2.824 (LB/D)*(1/5.39)*(1/QATM)=0.392 (MG/L)

TPATM=8.995E-02 (LB/D)*(1/5.39)*(1/QATM)=6.25E-3 (MG/L)

QSEPTIC= 315 TANKS IN BASIN*(0.10 FAILURE RATE)*175 (GAL/D)*1.E-6(MGD/GAL)=5.513E-3 (CFS)

CBOD5=180.0, TSS=120.5, TN=40.5, TP=8.0 MG/L ARE MEANS FROM RULE 64E-6 FAC EFFECTIVE 4-21-2002

QNED (STATION 695 AT WEEMS RD)=(QNED (STATION 690 AT US 319)/(DA S690))*(DA S695)

QNED (S695)= (11.910/10175)*(11011.1)=12.889 CFS

QDIRECT= (QNED S690/DA S690 NED)*(DA DIRECT)= (11.910/10175)*(1350)=1.5802 CFS

QLAFCRK (S810)=(QNED S690/DA S690 NED)*(DA S 810 LAFCRK)=(11.910/10175)*(1799)=2.1058 CFS

QGW= QSEEPAGE RATE* 400 AC=

9. NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

Following adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, which will be a component of the Basin Management Action Plan for the Lake Lafayette Basin. This document will be developed in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished.

The Basin Management Action Plan (B-MAP) will include:

- Appropriate allocations among the affected parties.
- A description of the load reduction activities to be undertaken.
- Timetables for project implementation and completion.
- Funding mechanisms that may be utilized.
- Any applicable signed agreements.
- Local ordinances defining actions to be taken or prohibited.
- Local water quality standards, permits, or load limitation agreements.
- Monitoring and follow-up measures.

It should be noted that TMDL development and implementation is an iterative process, and this TMDL will be re-evaluated during the BMAP development process and subsequent Watershed Management cycles. The Department acknowledges the uncertainty associated with TMDL development and allocation, particularly in estimates of nonpoint source loads and allocations for NPDES stormwater discharges, and fully expects that it may be further refined or revised over time. If any changes in the estimate of the assimilative capacity AND/OR allocation between point and nonpoint sources are required, the rule adopting this TMDL will be revised, thereby providing a point of entry for interested parties.

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APPENDIX A

WATER QUALITY DATA

Summary Table of Upper Lake Lafayette Inputs (A – 1)
Upper Lake Lafayette TSI & Weems Rd. TN/TP Values (A – 2)

ULL Inputs Summary Table

Station	Avg. BOD (mg/L)	Avg. TN (mg/L)	Avg. TP (mg/L)	Avg. TSS (mg/L)
695	5.468	0.577	0.198	14.074
806	0.613	0.489	0.120	11.189
810	1.005	0.367	0.171	9.500
860	0.753	0.372	0.092	5.833

Table A - 1

TN Error Figure:

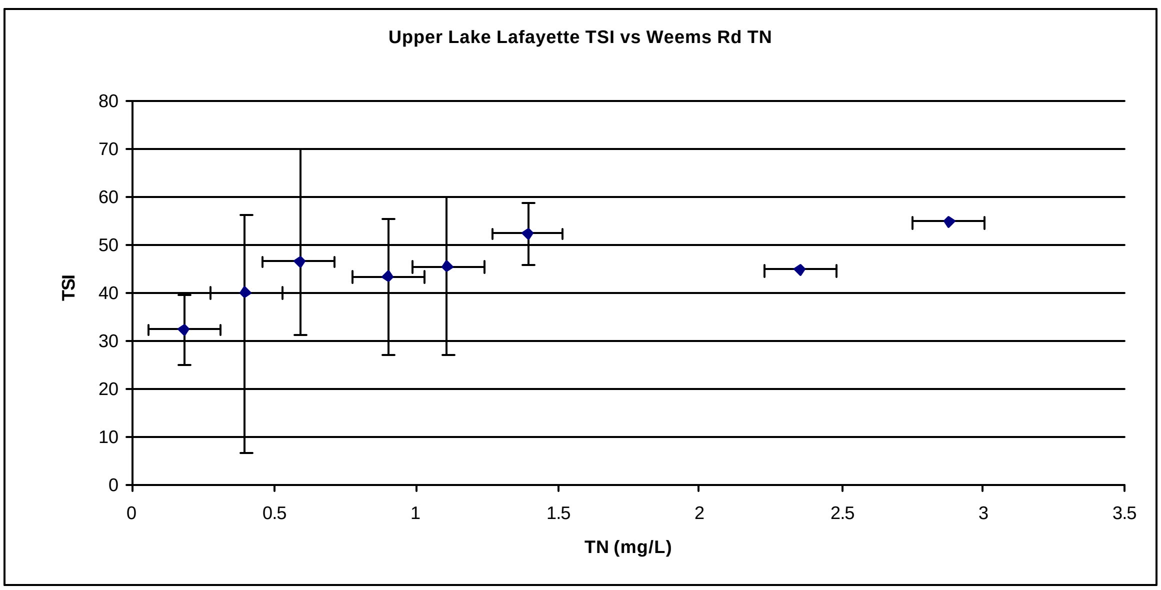


Figure A – 2.1

TP Error Figure:

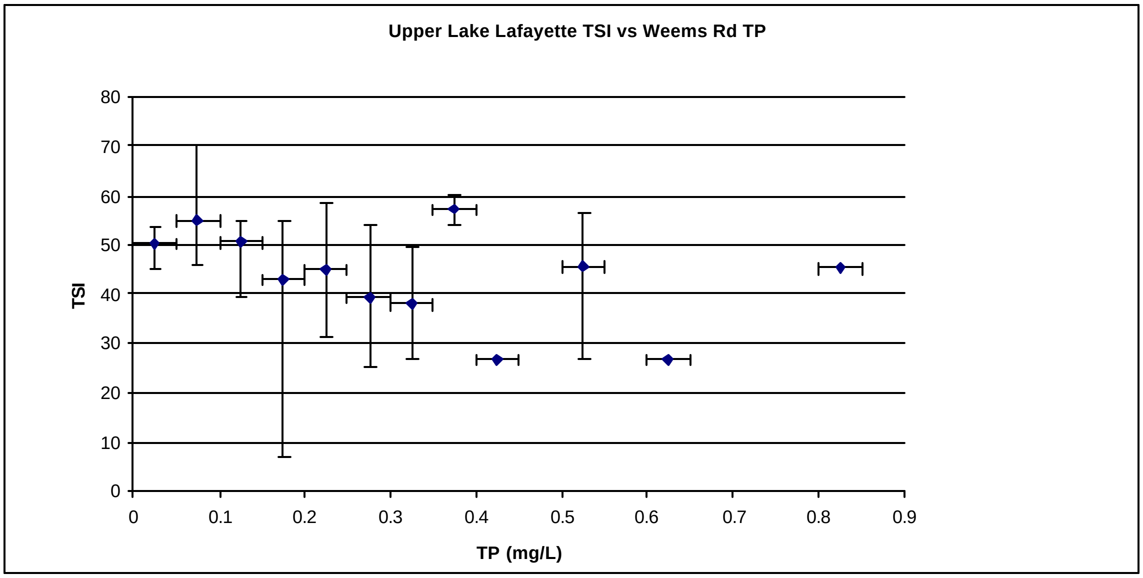


Figure A – 2.2

The raw data for the above tables is located in Appendix E.

APPENDIX B

RECKHOW MODEL

Reckhow Model Graphs (B – 1)
AHOD Model (Please refer to Appendix E)
Upper Lake Lafayette Diurnal DO (Please refer to Appendix E)

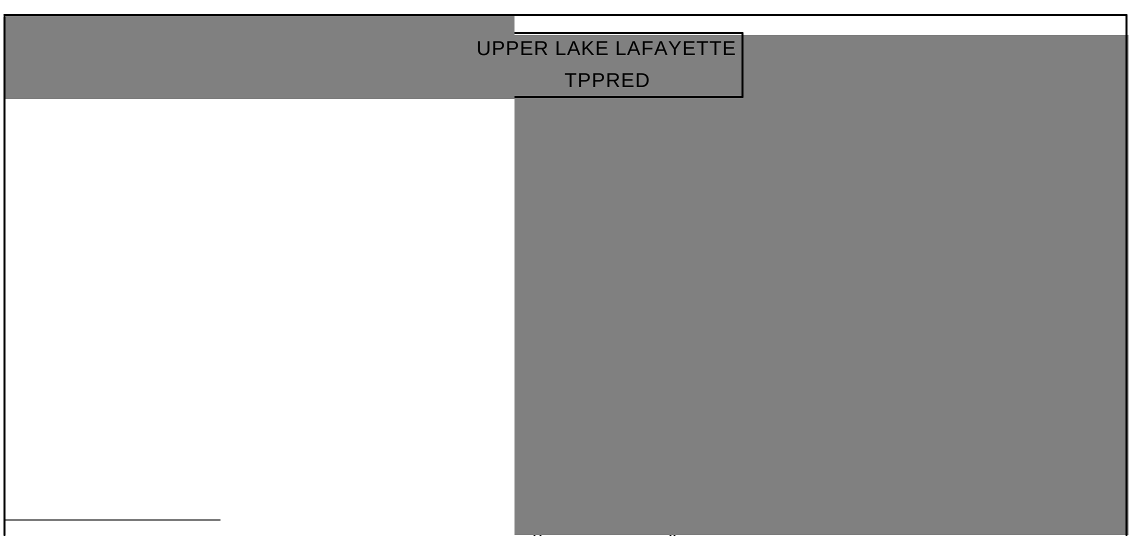


Figure B – 1.2

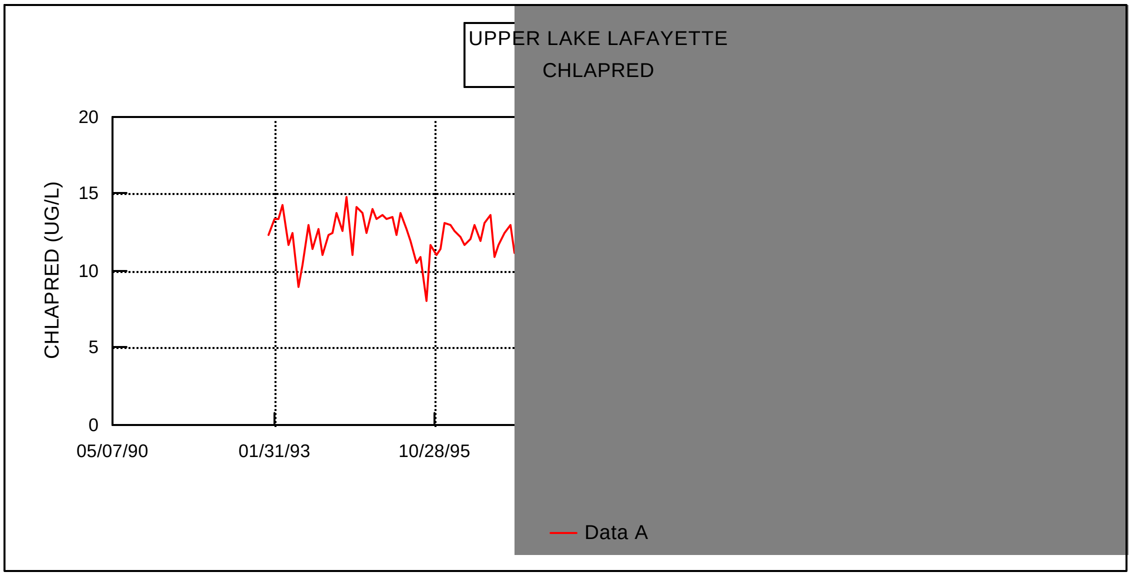


Figure B – 1.3

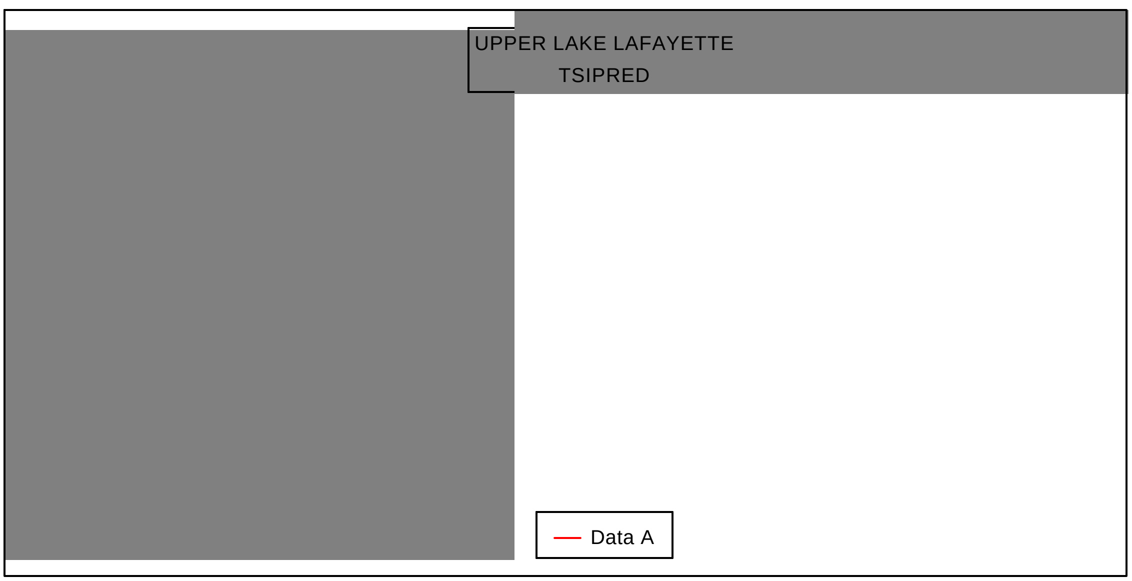


Figure B – 1.4

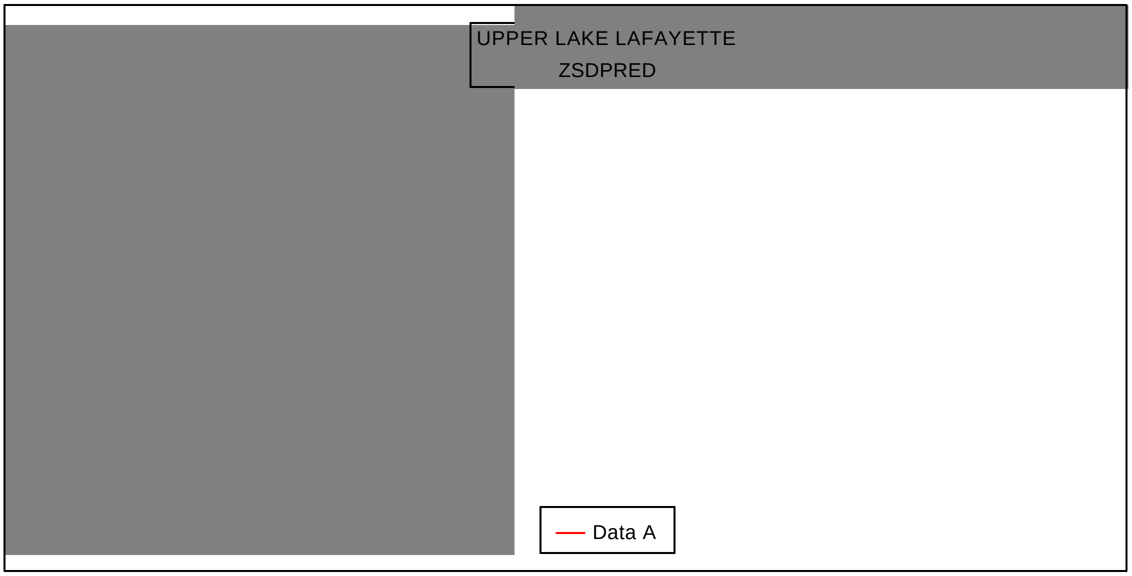
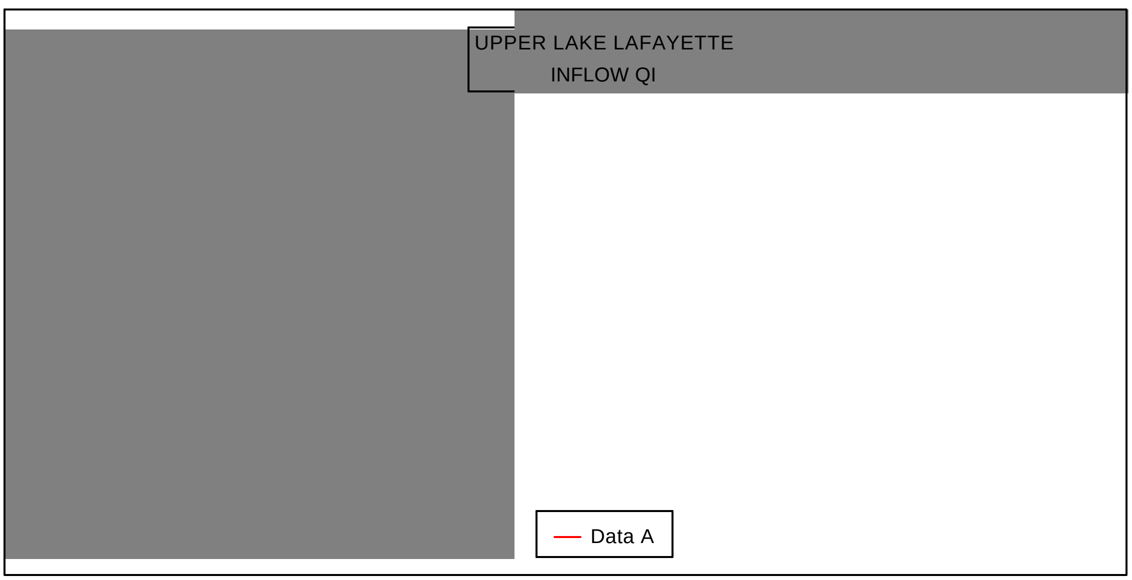


Figure B – 1.5



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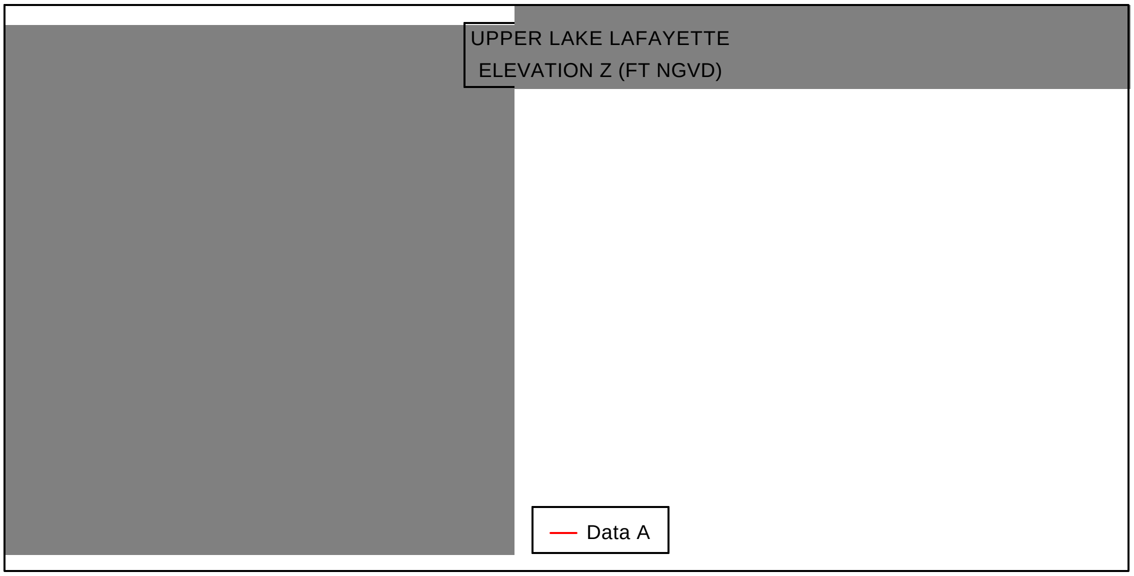
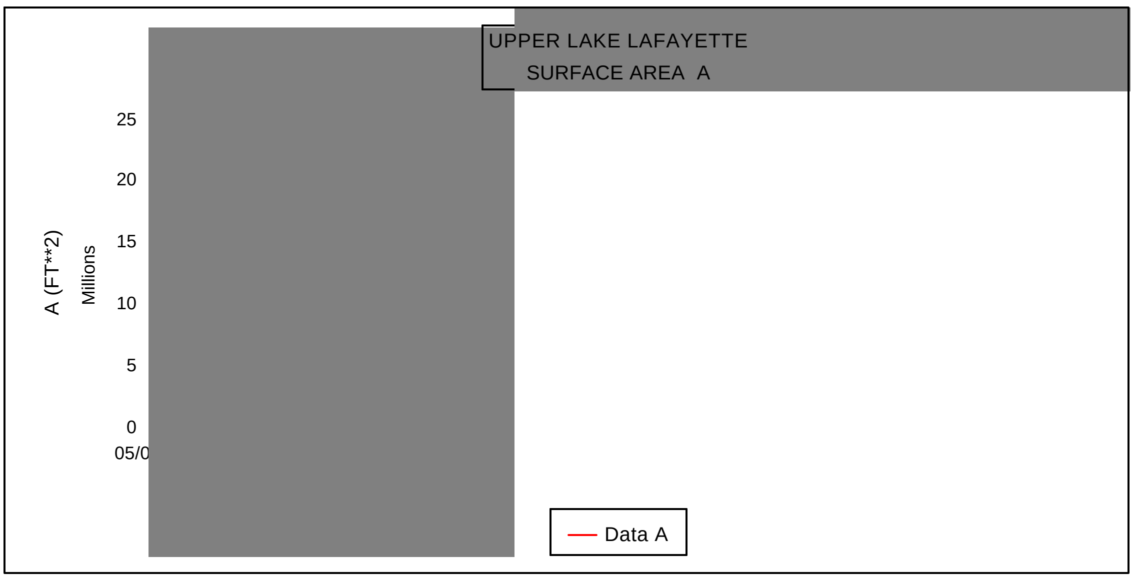


Figure B – 1.7



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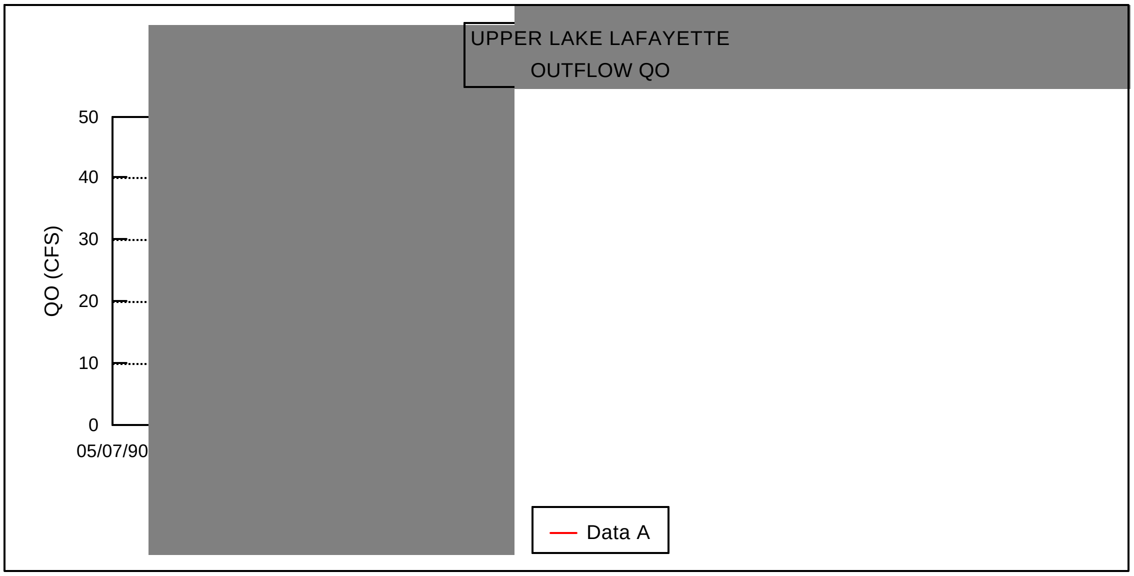

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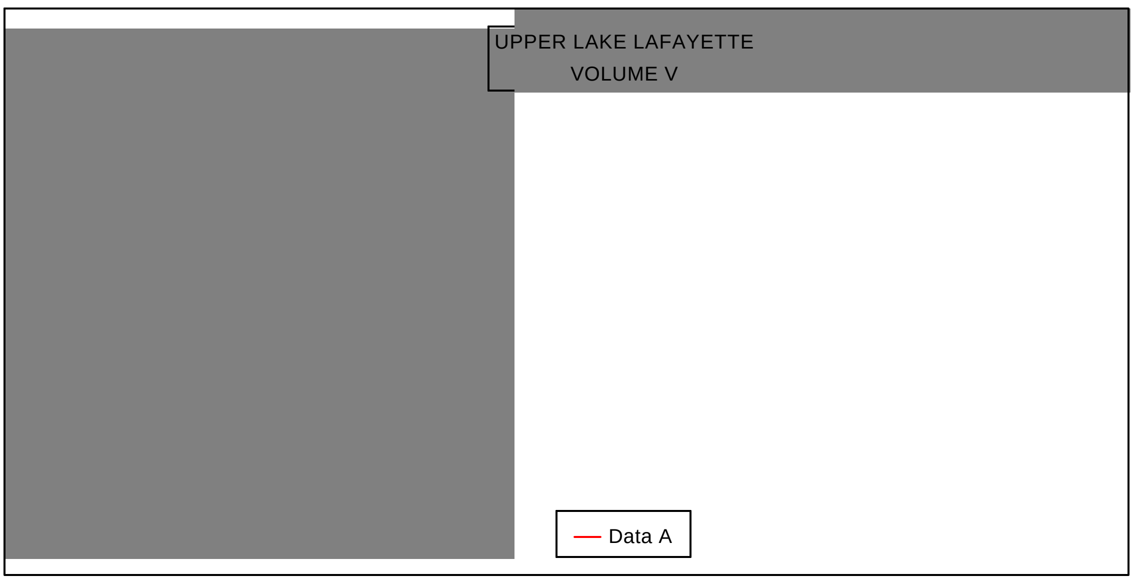

Figure B – 1.10

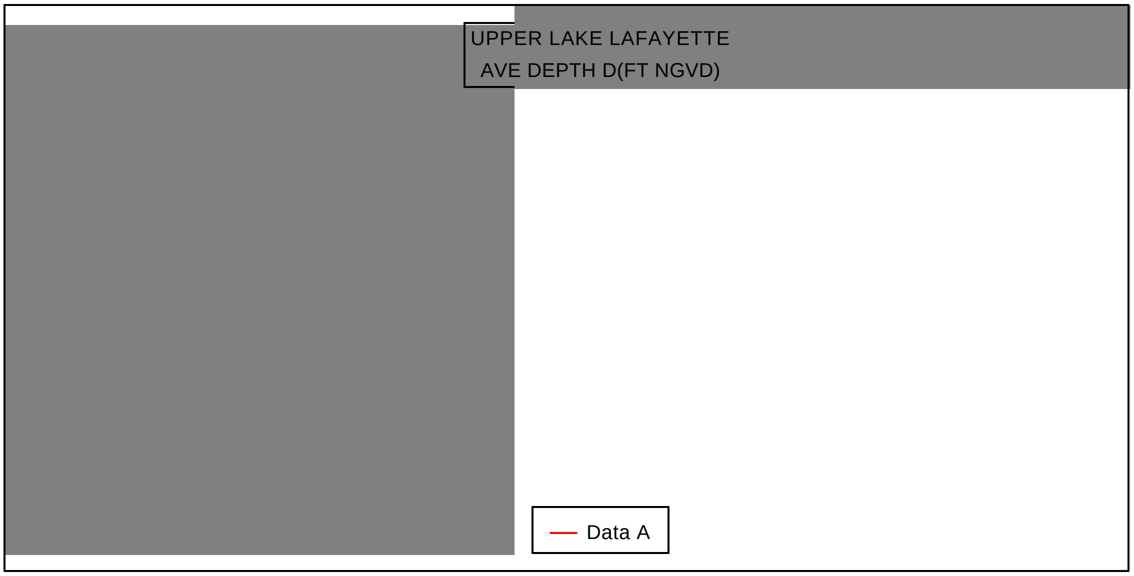

Figure B – 1.11

APPENDIX C

Northeast Drainage TN/TP Loadings (C-1)
Chemical Estimates with City of Tallahassee (COT) Basins (C-2)
Upper Lake Lafayette COT Loadings(C-3)

River Miles vs TN & TP Loads

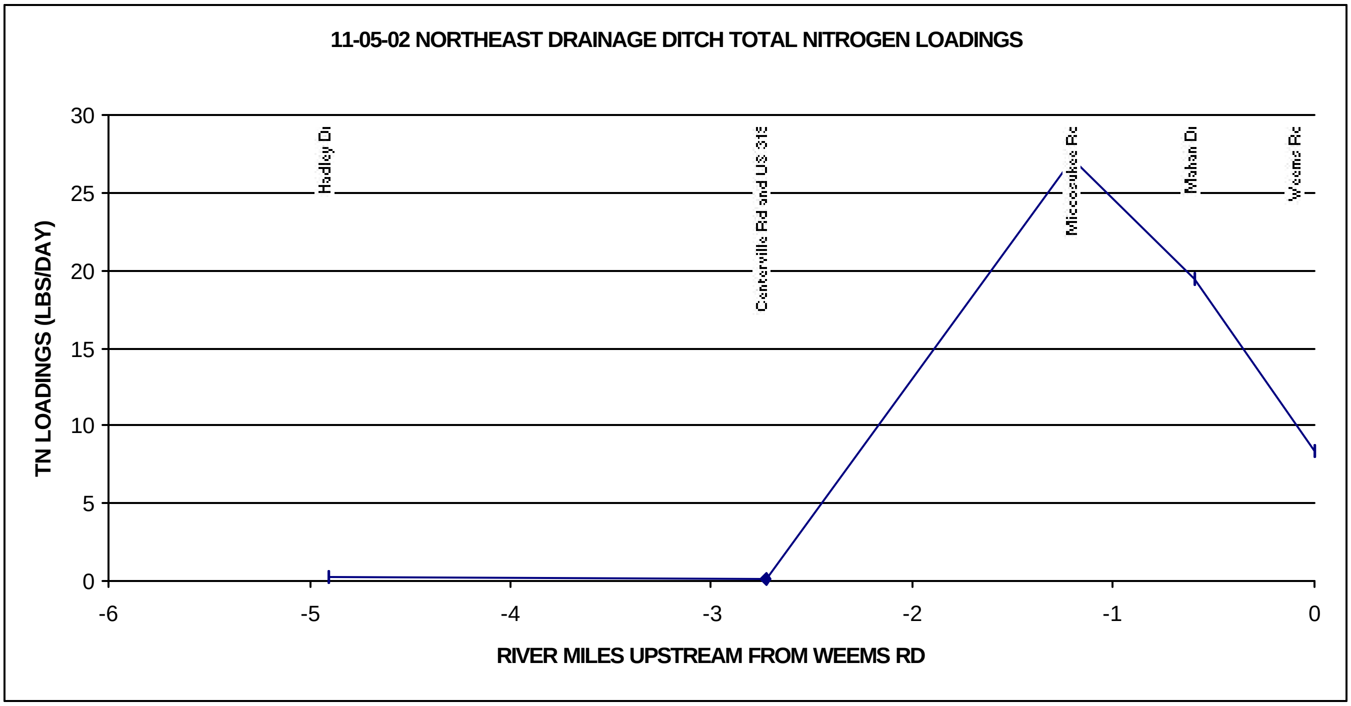
11-05-02 NORTHEAST DRAINAGE DITCH TOTAL NITROGEN LOADINGS
Hadley Dr
Centerville Rd and US 319
Miccosukee Rd
Mahan Dr
Weems Rd
TN LOADINGS (LBS/DAY)
30
25
20
15
10
5
0
-6
-5
-4
-3
-2
-1
0
RIVER MILES UPSTREAM FROM WEEMS RD

Figure C – 1.1

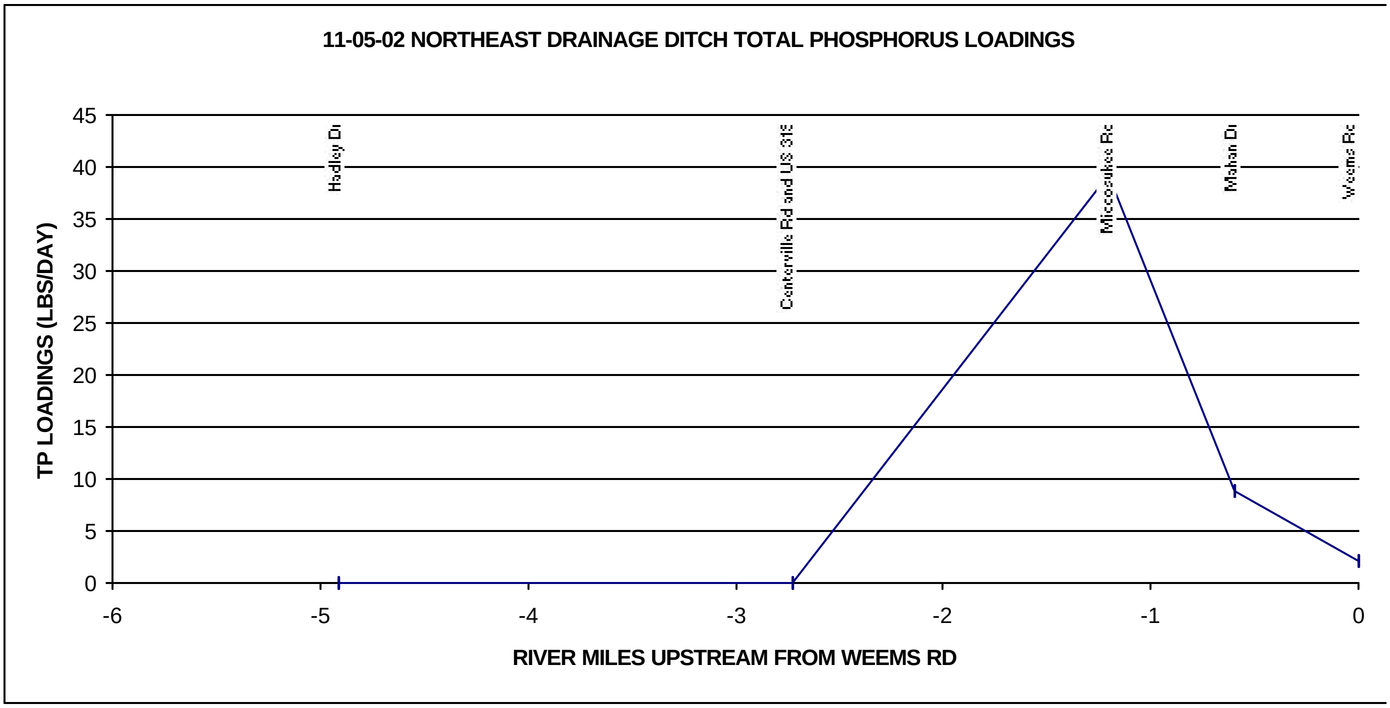

Figure C – 1.2

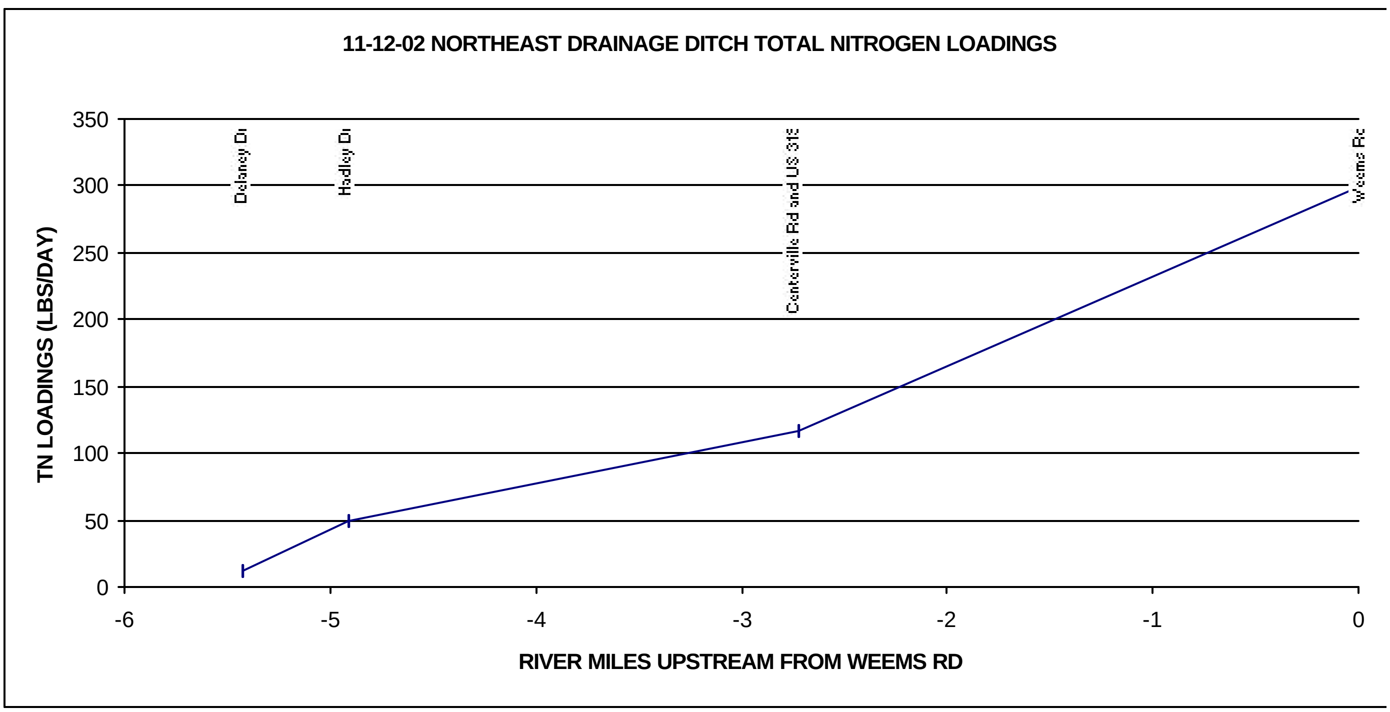

Figure C – 1.3

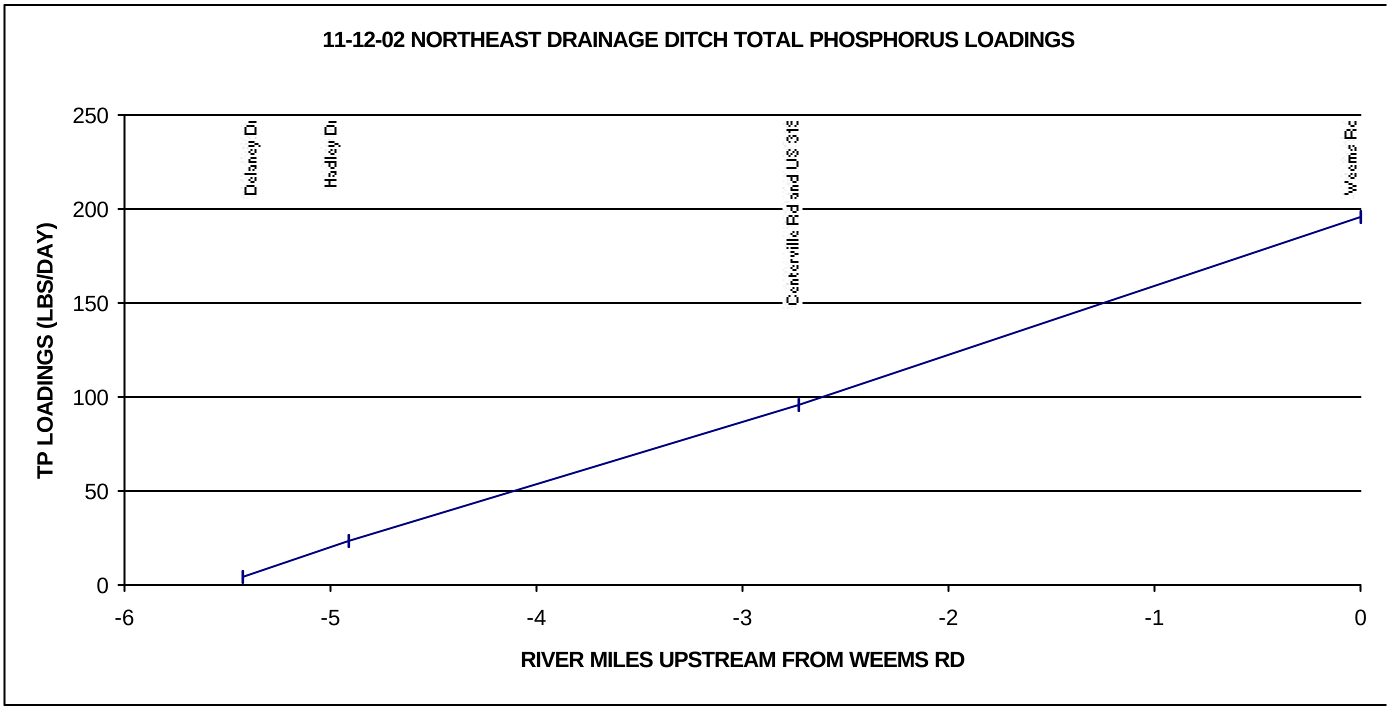

Figure C – 1.4

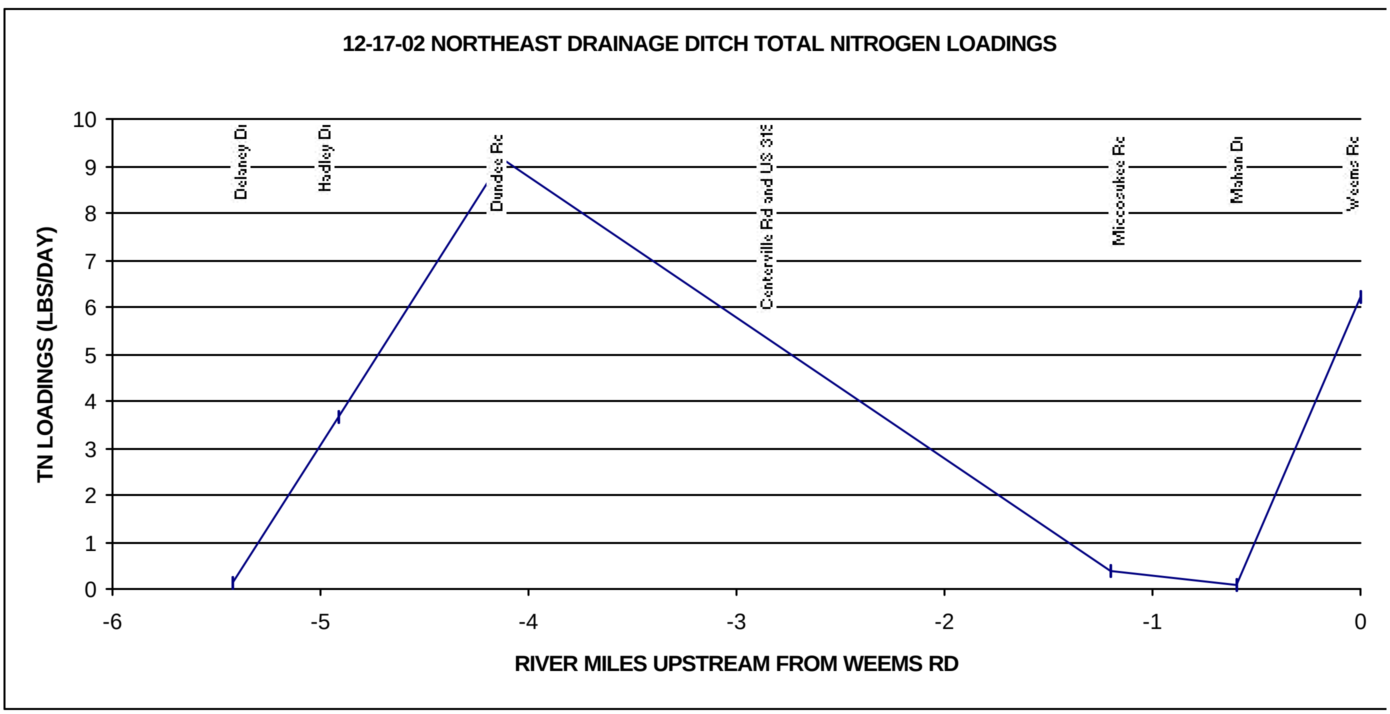

Figure C – 1.5

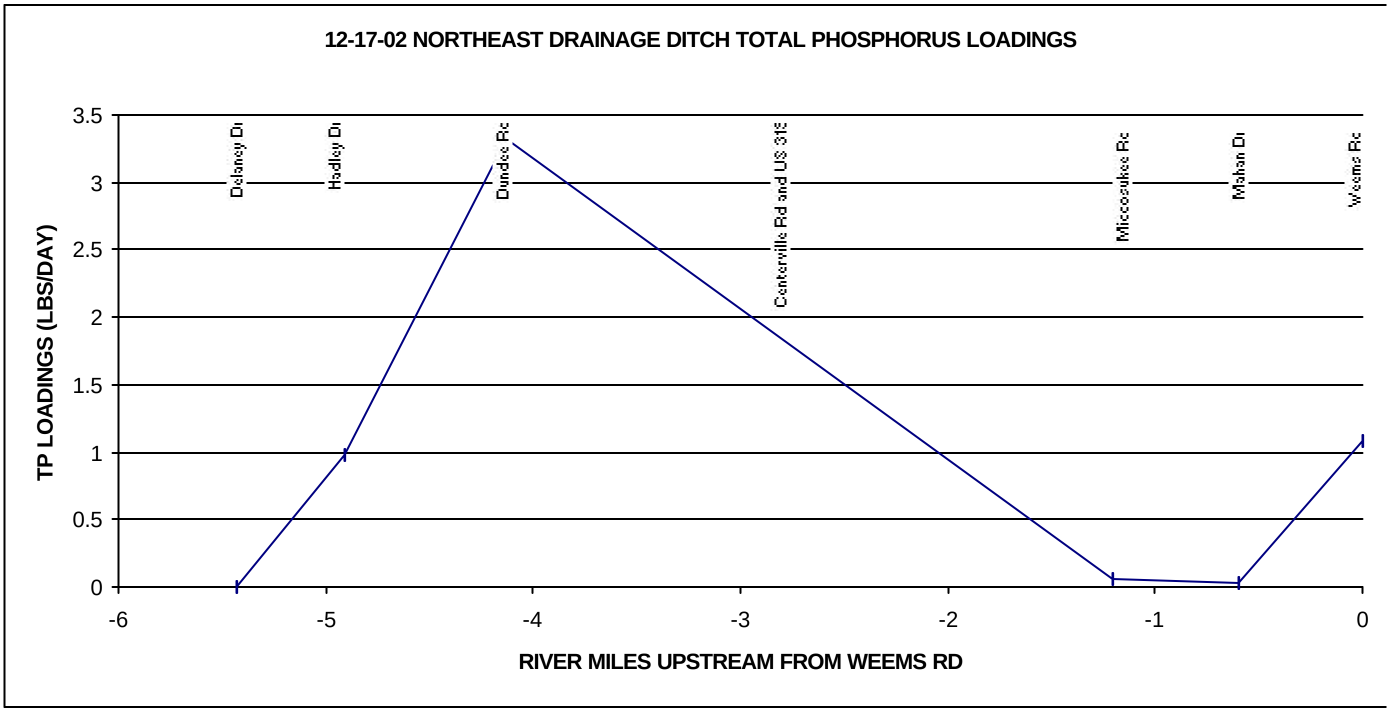

Figure C – 1.6

City of Tallahassee TN, TP, BOD, TSS Loads

	Mass Loading			
Watershed	**Total-N (lbs/yr)**	**Total-P (lbs/yr)**	**BOD (lbs/yr)**	**TSS (lbs/yr)**
Alford Arm WS (LAKE LAFAYETTE BASIN)	3,279	700	14,649	71,449
Betton Woods WS (LAKE LAFAYETTE BASIN)	2,957	733	17,767	70,577
Buck Lake CB (LAKE LAFAYETTE BASIN)	898	207	4,214	34,398
Capital Medical Center CB (LAKE LAFAYETTE BASIN)	654	134	2,792	16,801
Celebration Baptist Church CB (LAKE LAFAYETTE BASIN)	21	3	196	487
Desoto Lakes WS (LAKE LAFAYETTE BASIN)	1,114	357	5,350	26,066
East 27 CB (LAKE LAFAYETTE BASIN))	415	101	2,832	6,423
East Park Avenue WS (LAKE LAFAYETTE BASIN)	6,771	1,509	41,029	158,439
East Spring Church WS (LAKE LAFAYETTE BASIN))	1,033	310	5,539	23,802
Federal Correctional Institution CB (LAKE LAFAYETTE BASIN)	330	41	2,537	9,093
Foley Drive CB (LAKE LAFAYETTE BASIN)	37	14	412	1,762
Gilbert Pond WS (LAKE LAFAYETTE BASIN)	1,261	255	6,027	24,105
Goose Pond WS (LAKE LAFAYETTE BASIN)	5,251	1,234	31,961	143,328
Harriman Circle CB (LAKE LAFAYETTE BASIN)	169	64	1,688	7,523
I-10/90 WS (LAKE LAFAYETTE BASIN)	6,600	1,738	30,642	219,163
Killarney Plaza CB (LAKE LAFAYETTE BASIN)	72	14	570	1,741
Lafayette Oaks CB (LAKE LAFAYETTE BASIN)	800	222	5,404	31,704
Lake Ella CB (LAKE LAFAYETTE BASIN)	591	50	2,279	1,755
Lake Heritage WS (LAKE LAFAYETTE BASIN)	924	265	5,849	31,373

Lake Kanturk WS (LAKE LAFAYETTE BASIN)	794	189	5,427	27,822
Lake Killarney WS (LAKE LAFAYETTE BASIN)	1,550	462	10,505	56,928
Lake Kinsale WS (LAKE LAFAYETTE BASIN)	349	77	2,263	8,515
Lake McBride WS (LAKE LAFAYETTE BASIN)	1,832	360	7,950	38,241
Lake Saratoga WS (LAKE LAFAYETTE BASIN)	918	301	7,061	31,039
Lake Sheelin CB (LAKE LAFAYETTE BASIN)	221	81	2,261	10,270
Lake Tom John WS (LAKE LAFAYETTE BASIN)	631	128	3,009	11,976
Lincoln High WS (LAKE LAFAYETTE BASIN)	2,672	691	15,031	67,352
Lower Kanturk WS (LAKE LAFAYETTE BASIN)	423	179	1,598	10,505
Lower Lafayette WS (LAKE LAFAYETTE BASIN)	6,612	1,069	20,859	122,213
Martinez WS (LAKE LAFAYETTE BASIN)	2,312	789	10,640	53,294
Maylor CB (LAKE LAFAYETTE BASIN)	536	150	3,679	18,696
McCord Park WS (LAKE LAFAYETTE BASIN)	2,217	608	16,008	77,471
Melody Hills CB (LAKE LAFAYETTE BASIN)	197	57	1,139	4,602
Miles WS (LAKE LAFAYETTE BASIN)	1,160	373	5,351	26,771
Millstone Creek WS (LAKE LAFAYETTE BASIN)	1,686	488	9,186	44,317
Mom and Dads CB (LAKE LAFAYETTE BASIN)	911	219	3,944	21,147
Moore Pond CB (LAKE LAFAYETTE BASIN)	677	140	3,030	15,921
Mt Hornbem WS (LAKE LAFAYETTE BASIN)	1,384	493	7,300	49,120
Mt Sinai WS (LAKE LAFAYETTE BASIN)	525	180	2,554	13,085
Pedric CB (LAKE LAFAYETTE BASIN)	439	97	2,570	14,737
Phillips Road CB (LAKE LAFAYETTE BASIN)	1,030	202	6,797	33,279
Piedmont WS (LAKE LAFAYETTE BASIN)	978	277	6,791	25,903
Piney Z WS (LAKE LAFAYETTE BASIN)	1,431	214	4,747	20,546
Roberts Pond WS (LAKE LAFAYETTE BASIN)	2,715	666	14,430	61,315
Royal Oaks Creek WS (LAKE LAFAYETTE BASIN)	996	365	9,255	45,337
Smith 1 CB (LAKE LAFAYETTE BASIN)	359	121	3,107	12,515
Smith 2 CB (LAKE LAFAYETTE BASIN)	120	30	526	1,471
Smith 3 CB (LAKE LAFAYETTE BASIN)	157	60	857	3,707
Smith 4 CB (LAKE LAFAYETTE BASIN)	133	39	609	2,125
Southwood Plantation CB (LAKE LAFAYETTE BASIN)	125	40	587	3,755
st Peters CB (LAKE LAFAYETTE BASIN)	28	7	168	405
Upper Lafayette WS (LAKE LAFAYETTE BASIN)	1,376	421	7,881	26,688
Vedura II WS (LAKE LAFAYETTE BASIN)	1,374	405	8,132	37,999
Waverly WS (LAKE LAFAYETTE BASIN)	443	164	4,197	18,226
Welaunee WS (LAKE LAFAYETTE BASIN)	1,240	371	5,215	40,453
Witfield Plantation CB (LAKE LAFAYETTE BASIN)	692	204	3,718	22,498
LOAD SUM (Minus Actual Closed Basins And Piney Z)=	**25,379**	**6,157**	**155,932**	**653,686**
CONCENTRATION (mg/L)=				

<u>Table C – 2</u>

Table C - 3

UPPER LAKE LAFAYETTE COT LOADS COTLD.WK4											
					0.00138128						
	PRIMARY	ULTIMATE	UPPER	VOL	Q	TN	TN	TN	TP	TP	TP
NAME OF WATERSHED	RECEIVING STREAM	RECEIVING	LAKE LAFAYETTE	AC-FT/YR	CFS	LB/YR	LB/D	MG/L	LB/YR	LB/D	MG/L
		STREAM	DA (AC)								
KILLARNEY PLAZA	NED	NED	30	25	0.034532	72	0.197260274	1.059812737	14	0.038356164	0.206074699
FOLEY DR CB	NED	NED	29	13	0.01795664	37	0.101369863	1.047357673	14	0.038356164	0.396297498
GOOSE POND	NED	NED	2521	1508	2.08297024	5318	14.56986301	1.29772789	1284	3.517808219	0.31332881
ST PETERS CB	NED	NED	35	9	0.01243152	28	0.076712329	1.144859438	7	0.019178082	0.286214859
PIEDMONT	GOOSE POND TRIB	NED	611	287	0.39642736	981	2.687671233	1.257835239	280	0.767123288	0.359015155
WAVERLY	GOOSE POND TRIB ??	NED	366	138	0.19061664	452	1.238356164	1.205302327	175	0.479452055	0.466654662
HARRIMAN CIRCLE CB	GOOSE POND TRIB	NED	146	50	0.069064	171	0.468493151	1.258527625	66	0.180821918	0.485747504
MELODY HILLS CB	NED	NED	177	66	0.09116448	197	0.539726027	1.098395987	57	0.156164384	0.317810006
CAPITAL MEDICAL CENTER CB	NED	NED	253	198	0.27349344	680	1.863013699	1.263805873	160	0.438356164	0.297366088
LAKE ELLA CB	MCCORD PARK DITCH	NED	196	172	0.23758016	601	1.646575342	1.285827388	58	0.15890411	0.124089831
MCCORD PARK	MCCORD PARK DITCH	NED	1141	623	0.86053744	2223	6.090410959	1.313070556	616	1.687671233	0.363855809
BETTON WOODS	MCCORD PARK DITCH	NED	1486	831	1.14784368	2967	8.128767123	1.313872338	744	2.038356164	0.329464449
PHILLIPS RD	NED	NED	433	352	0.48621056	1051	2.879452055	1.098744463	229	0.62739726	0.239402932
EAST PARK AVE	PARK AVE DITCH	NED	2644	1827	2.52359856	6740	18.46575342	1.357556758	1507	4.128767123	0.3035368
FEDERAL CORRECTIONAL INSTITUTION CB	PARK AVE TRIB 2	NED	107	131	0.18094768	330	0.904109589	0.926999054	41	0.112328767	0.11517261
CUMULATIVE WS AT US 319 UPS WEEMS POND	WEEMS POND	NED	10175	6230	8.6053744	21848	59.85753425	1.29050677	5252	14.3890411	0.310222517
CUMULATIVE WS AT WEEMS RD CALCULATED	WEEMS POND	NED	11011.1	6741.931499	9.312495141	23643.29364	64.77614696	1.29050677	5683.56729	15.57141724	0.310222517

CALCULATED											
LINCOLN HIGH WS AT CONNER BLVD		LAFAYETTE CRK									
CUMULATIVE LINCOLN HIGH WS AT CSX RR		LAFAYETTE CRK	1799	794	1.09673632	2717	7.443835616	1.25923209	733	2.008219178	0.339719221
UPPER LAKE LAFAYETTE	DEP ESTIMATE	UPPER LAKE LAF.	400								
DIRECT RUNOFF +PINEY Z SUBDIVISION	DEP ESTIMATE	UPPER LAKE LAF.	1350								
UPPER LAKE LAFAYETTE WS SUM	COT ORIGINAL EST.	UPPER LAKE LAF.	1750	752	1.03872256	2621	7.180821918	1.282584027	1023	2.802739726	0.500604143
DIRECT RUNOFF +PINEY Z SUBDIVISION	COT EST. 8-28-03	UPPER LAKE LAF.				1376	3.769863014		421	1.153424658	

APPENDIX D

PUBLIC NOTICE

APPENDIX E

Water Quality CD